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ACOUSTIC AND VESTIBULAR BAROMETRY

AIR PRESSURE EFFECTS ON HEARING AND EQUILIBRIUM OF UNOPERATED AND FENESTRATED EARS

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INTRODUCTION

This preliminary report describes several of the effects on hearing and equilibrium caused by an increase or decrease in air pressure on the middle and inner ear structures. Changes in the hearing threshold plus vertigo produced by variations in air pressure have been studied in both unoperated and fenestrated ears.

APPARATUS

The apparatus used was constructed as simply as possible so that it could be easily duplicated. The items in use are a water manometer, ear plugs, and a Western Electric 6BP audiometer with a mod-

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ified air conduction receiver. The water manometer registers plus or minus 100 cm. of water pressure and is graduated in 2-cm. steps. Sections of 7-mm. outside diameter glass tubing are supported in a wooden frame as in the accompanying illustration.

The ear plugs are made in several sizes to obtain an accurate fit in the external auditory canal. The rubber tip shown in the illustration was obtained from the war surplus armored vehicle head set H-16/U.

To study the effects of air pressure change on air conducted sound at threshold, several modifications were made in the Western Electric air conduction receiver. The parts are readily available, and the changes in the receiver can be made with simple tools. When the modifications have been made as shown in the illustration, Duco colorless cement or Collodion is applied in successive layers until the receiver is air-tight. The joint between the needle and adapter is sealed by vaseline applied to the contact surfaces.

PROCEDURE

Disturbances in equilibrium caused by variations in air pressure were studied first because this test is a simpler procedure and prepares the patient for the more demanding hearing test. The ear piece is coated with boric acid ointment to obtain an air-tight fit in the external auditory canal. It is held firmly in place by the patient. Artificial pressure is generated, first the negative then the positive. Negative pressure is used first because it seats the obturator in the external auditory canal, thus reducing air leaks which are apt to occur when positive pressure is applied. In each case, both the negative and the positive, pressure is increased or diminished to a tolerance point of the patient. No pressure changes greater than 60 cm. of water in unoperated ears and 40 cm. in fenestrated ears are used.

The patient is requested to report any sensation produced by pressure change, but no mention is made of the possible sensation of vertigo in order to reduce the factor of suggestion. When the ear drum is intact, the patients report a feeling of "suction," "pulling," or "pressure" which may be slightly uncomfortable when the greater ranges of pressure are used. If the fistula of a fenestrated ear is still patent, the vertigo caused by pressure change is dramatic and is produced by lesser variations in range. Patients who have had the membrana tympani destroyed by disease, and patients who have had the fenestration operation followed by closure of the fistula ex-

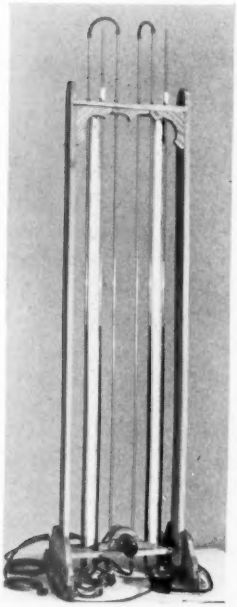

Fig. 1.—Water manometer.

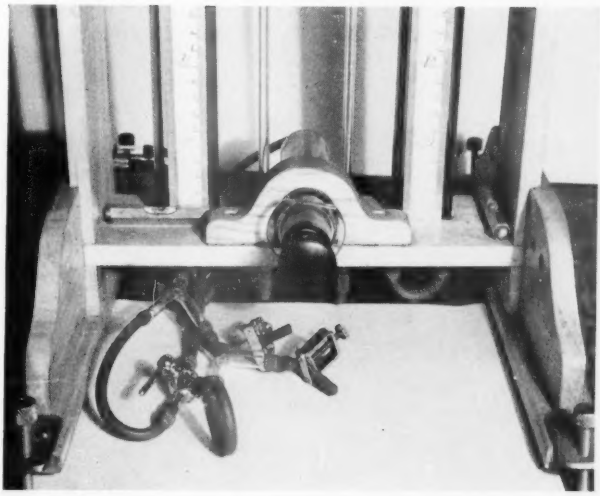

Fig. 2.—Water manometer—Detail of base.

perience either a minimal sensation of pressure or total lack of sensation up to 60 cm. of water. In this series, the pressure levels of 40 cm. and 60 cm. were chosen arbitrarily as the upper limit of the test because of the remote possibility that higher pressure variations might be damaging to the ear.

Following the preliminary test for vertigo, a test for bone conducted sound at threshold is done. The patient holds the ear piece as in the vestibular test. The bone conduction receiver is placed over the mastoid antrum as in routine audiometry. The threshold of hearing at 1024 cycles is determined while pressure is maintained in the external canal at normal level. The sound is held at precisely the audible level, and the air pressure is then varied as in the test for vertigo. The patient is instructed to ignore the sensation of "pressure" or "pulling" in the external auditory canal and to concentrate on the perception of sound. He is asked to report any change in sound produced by pressure variations, but is not given a clue as to what these changes may be.

In most tests, when the bone conduction at 1024 is 30 or more decibels greater than the air conduction, there will be no change in the intensity of the sound with pressure variations. If the bone conduction is less than 30 decibels greater than the air conduction at 1024, the sound will probably vary in intensity. In most instances, the sound will decrease until it is inaudible. Sometimes, the sound will return to audibility after a short rest period, but the patient will report the sound to be "far away" or "changed" in some manner which he is unable to describe accurately. When the sound is heard better by bone conduction in the ear which is opposite to the one tested, the phenomenon called "crossed hearing" may occur. In this phenomenon, sound disappears in the ear being tested and becomes audible in the opposite ear. When testing bone conduction with a frequency of 8192 cycles, the test should be performed as quickly as possible because of the more rapid fatigue factor at the higher frequencies.

The technique of the air conduction test is similar to that of the bone conduction test. The especially designed receiver is held firmly in the external canal by the patient. The threshold for hearing is determined at normal pressure. Changes in threshold hearing are noted when the pressure is varied as is done in the bone conduction test. Most patients report a decrease in the intensity of the sound which returns later following a rest period.

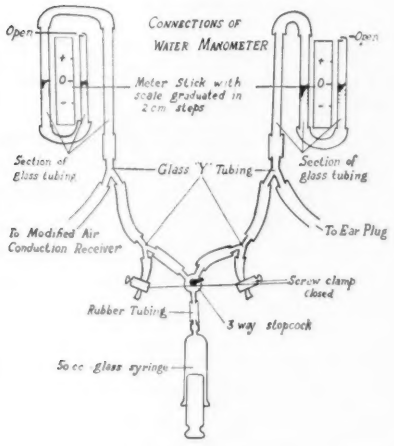

Fig. 3.—Connections of water manometer—Diagrammatic.

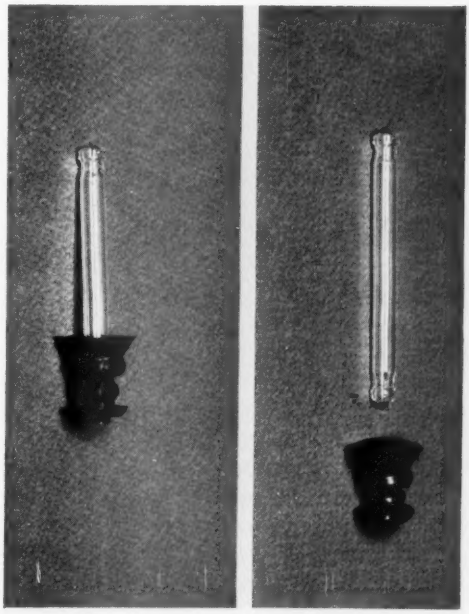

Fig. 4.—Ear plug.

CLASSIFICATION OF PATIENTS

One of us (M. J.) has used the time differential factor between the hearing by bone conduction and air conduction, using tuning forks, to test hearing. In the cases tested with pressure change, the audiometric decibel intensity difference between bone conduction and air conduction is related to the variation in the bone conduction hearing at threshold produced by pressure change. A classification of impaired hearing by audiometry was developed based on the audiometric decibel intensity difference between bone conduction and air conduction thresholds. This classification is similar to the time differential used in testing hearing by tuning forks.

The patients' audiograms were divided into eight types selected on the basis of the difference between bone conduction and air conduction threshold at 256, 1024, and 4096 cycles. These frequencies were chosen to represent the three registers: low, middle, and high. A subsequent supplemental study will include an analysis of other audiometric frequencies. Table I presents this classification in outline form.

SUMMARY OF TESTS ON UNOPERATED EARS

The results of pressure tests on 32 ears are summarized in Table II. On preliminary analysis, the effects of pressure upon the hearing of bone conducted sound at threshold were found to be directly related to the degree of difference in the intensity used to produce threshold hearing for bone conduction and air conduction. The magnitude of this difference which we call "intensity differential" has been recorded in decibels using the frequencies 256, 1024, and 4096. These frequencies were used as indicators of low, middle, and high registers. The total of intensity difference at these three frequencies was also recorded in decibels.

The patients were placed in two groups which were selected on the basis of bone conduction response to sound at 256 and 1024 cycles when subjected to varying barometric pressures. Group I, ears 1 through 15, had no change in bone conduction hearing at threshold when tested with tones of *both* 256 *and* 1024 *cycles* and subjected to either positive or negative air pressure change. Group II, ears 16 through 32, showed a change in hearing by bone conduction for tones at *either* 256 *or* 1024 *cycles*. This change in hearing consisted of an increase or decrease in the intensity of the threshold sound when ears were subjected to either increased or decreased pressure.

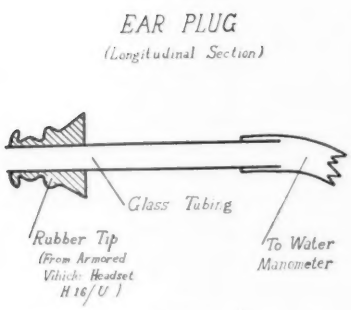

Fig. 5.—Ear plug—Diagrammatic.

Fig. 6.—Modified Western Electric 705A air conduction receiver.

The effects of the same tests for the 8192 bone conducted tone showed some correlation to the effects noted with the 256 and 1024 bone conduction trials. However, as has been mentioned, fatigue was an important factor at the higher frequencies and the effects observed were of smaller magnitude than those obtained at the lower frequencies. Vibratory sense, pain sense, tactile sense and perhaps other senses complicate the recording of a pure hearing sense. This is particularly applicable to the upper and lower limits of sound frequencies.

The frequencies used in this series were chosen because they represented the lower, middle, and upper registers available on the Western Electric 6BP audiometer. A supplemental series includes other frequencies.

Our results are summarized in columns according to audiometric frequency and receiver type. Subdivisions of each column are used for the air pressure data and effects. The audiometric decibel differences between the bone conduction and air conduction at 256 and 1024 are included in the 256 bone and 1024 bone columns for convenience. This information is graphically demonstrated in the scattergram analysis of the tests.

AN ANALYSIS OF THE EFFECTS OF AIR PRESSURE CHANGE ON BONE CONDUCTED HEARING

There is a striking relationship between the effects of air pressure change on bone conducted sound at threshold for tones of 256 and 1024 cycles and the magnitude of the decibel difference between bone conduction and air conduction thresholds. The relationship has been visualized by means of a scattergram.

As previously stated, the ears have been divided into two groups, depending upon the effects observed at 256 and 1024 cycles. Group I, represented by O in the scattergram, includes the ears showing *no* change in bone conduction sound at threshold for both 256 and 1024 with either positive or negative air pressure change. Group II, represented by X in the scattergram, includes the ears showing change in bone conducted sound at threshold at *either* 256 *or* 1024 with *either* positive *or* negative air pressure change.

At both 256 and 1024 cycles, most of the ears in Group II have less than 30 decibels difference between bone conduction and air conduction thresholds, while most of Group I ears have 30 decibels or more difference. Thirty decibels seems, therefore, a critical level

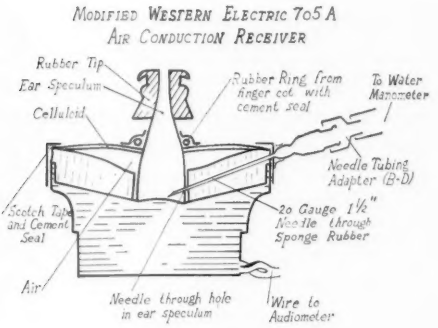

Fig. 7.—Modified Western Electric 705A air conduction receiver—Diagram of longitudinal section.

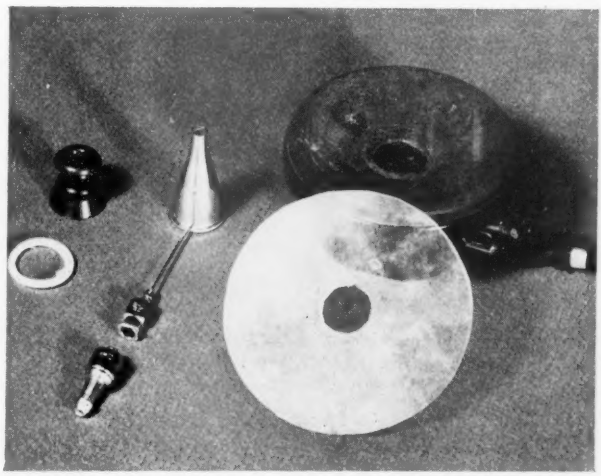

Fig. 8.—Parts used to modify Western Electric air conduction receiver.

of transition between Groups I and II. It may even represent the decibel level which indicates the mobility or fixation of the stapes.

SUMMARY AND ANALYSIS OF TESTS ON FENESTRATED CASES

The results of air pressure change on 8 fenestrated ears are summarized in Table III. Since the possible adverse effects of pressure changes on the fenestrated ear are unknown, the test was limited to 1024 cycles and the highest pressure used was 40 cm. of water. No untoward effects have resulted from this technique. Other frequencies will be used in future tests and the pressure will be cautiously varied.

Ears 1 and 2 retained an improvement in the hearing following operation, ear 2 maintaining excellent hearing. In the other 6 ears, the hearing is now unsatisfactory, having returned to the pre-operative level. The pressure test at 1024 by air conduction showed a change in the sound in only 1 of 7 cases. Using bone conducted sound, we found no change following pressure variations in all 7 cases. A functioning drum and ossicular chain is necessary in order to obtain the changes in hearing due to pressure change. The same statement applies to dampening.

There was no vertigo noted in the 32 unoperated ears summarized in Table I. In the 8 fenestrated ears, vertigo was noted in the 2 ears in which a permanent improvement in hearing was obtained by fenestration. There seemed to be a relationship between the degree of improvement in hearing and the degree of vertigo caused by the test. Ear number 8 showed no vertigo on pressure change, and at re-operation was found to have a bony closure of the fenestrum.

CONCLUSIONS

Some of the effects of air pressure change on the hearing and equilibrium of 32 unoperated and 8 fenestrated ears have been described.

The results emphasize the importance of the dampening function of the drum and ossicles in the low and middle frequencies. A functioning drum and ossicular chain is necessary to obtain changes in hearing due to altered air pressure.

The effects of changes in air pressure on bone conducted sound at 256 and 1024 cycles are in proportion to the magnitude of the audiometric decibel differential between the bone conduction and

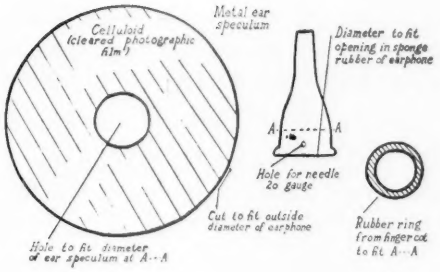
Metal ear speculum
Celluloid (cleared photographic film)
Diameter to fit opening in sponge rubber of earphone
A
A
Hole for needle 20 gauge
Cut to fit outside diameter of earphone
Rubber ring from finger cot to fit A--A
Hole to fit diameter of ear speculum at A--A

Fig. 9.—Parts used to modify Western Electric air conduction receiver—Diagrammatic.

Fig. 10.—Air conduction test.

air conduction thresholds. A differential of 30 decibels is critical and may indicate stapes fixation.

In 8 fenestrated ears, there was a correlation between the hearing improvement and the vertigo resulting from air pressure change. There was no vertigo noted with air pressure change in the 32 unoperated ears.

Further study may establish the air pressure test as a test for stapes fixation in the unoperated ear and as a test for patency of the fenestrum in the fenestrated ear.

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TABLE I–AUDIOGRAM CLASSIFICATION

Audiogram Type	Frequency		
	256	1024	4096
1	BC ⋗ AC	BC ⋗ AC	BC ⋗ AC
2	BC ⋖ AC	BC ⋖ AC	BC ⋖ AC
3	BC ⋗ AC	BC ⋖ AC	BC ⋖ AC
4	BC ⋗ AC	BC ⋗ AC	BC ⋖ AC
5	BC ⋖ AC	BC ⋗ AC	BC ⋖ AC
6	BC ⋖ AC	BC ⋖ AC	BC ⋗ AC
7	BC ⋗ AC	BC ⋖ AC	BC ⋗ AC
8	BC ⋖ AC	BC ⋗ AC	BC ⋗ AC

Diagnosis in nonsuppurative causes of impaired hearing has been based largely on tests of ability to hear air or bone conducted sound and the relation of the two. When the low tones have been impaired for air conduction and bone conduction maintained or increased, the inference was an impairment of the conduction apparatus.

A diminution in ability to hear air conducted high tones plus a diminished bone conduction inferred perception mechanism lesions. Any other combination has been classed as a mixed lesion.

The accompanying chart has demonstrated a more accurate classification of the bone and air conduction relationship together with a differential in intensity and time used to aid in such classification. Table I illustrates the intensity and time differential methods of classification.

TABLE II
PRESSURE TESTS ON 32 UNOPERATED EARS—GROUP I

Ear Number	Audiogram Type (Table I)	DB BC > AC 256	DB BC > AC 1024	DB BC > AC 4096	Total DB BC > AC 256, 1024, 4096	128 Air					256 Bone					1024 Air				
						Threshold in Db.	Pressure Increase in cm. water	Effect on Sound	Pressure Decrease in cm. water	Effect on Sound	Threshold in Db.	DB BC > AC 256	Pressure Increase in cm. water	Effect on Sound	Pressure Decrease in cm. water	Effect on Sound	Threshold in Db.	Pressure Increase in cm. water	Effect on Sound	Pressure Decrease in cm. water	Effect on Sound
1	1	35	30	55	120	50	40	-	40	+	15	35	60	0	60	0	55	40	0	40	0
2	1	60	55	30	145	40	20	-	20	+	-10	60	40	0	40	0	55	20	-	8	+
3	1	45	50	30	125	35	20	-	20	+	-10	45	40	0	40	0	45	10	-	20	-
4	1	35	45	55	135	35	40	-	40	-	10	35	60	0	60	0	55	40	-	40	-
5	1	15	35	25	75	25	40	-	40	-	10	15	60	0	60	0	40	40	-	40	-
6	1	35	50	25	110	45	40	-	60	0	15	35	40	0	40	0	55	40	-	40	+
7	1	50	30	35	115	45	60	0	40	-	-5	50	40	0	40	0	45	60	-	40	-
8	1	35	30	25	90	40	40	0	40	-	5	15	60	0	60	0	40	40	-	40	-
9	1	55	55	60	170	Not Heard					10	55	60	0	60	0	70	40	0	40	0
10	1	50	40	35	125	60	40	-	60	-	0	50	60	0	60	0	50	40	-	60	-
11	1	45	35	25	105	55	40	-	40	0	5	45	60	0	60	0	45	20	-	40	-
12	1	40	40	35	115	30	40	-	40	-	-10	40	60	0	60	0	40	40	-	40	-
13	1	25	35	5	65						-10	25	60	0	60	0					
14	1	40	30	20	90						-5	40	60	0	60	0					
15	1	40	45	35	120						10	40	60	0	60	0					

The above table summarizes the results of air pressure change on the hearing of 32 unoperated ears. The ears have been divided into two groups.

Group I includes the ears which have no change in bone conducted sound at threshold for both 256 and 1024 cycles with either positive or negative air pressure change. This group has a higher "intensity differential" than Group II.

Group II includes the ears showing change in bone conducted sound at threshold at either 256 or 1024 with either positive or negative air pressure change. This group has a lower "intensity differential" than Group I.

TABLE II—GROUP I—(Continued)

Ear Number	1024 Bone						8192 Bone					9747 Air				
	Threshold in Db.	DB BC > AC 1024	Pressure Increase in cm. water	Effect on Sound	Pressure Decrease in cm. water	Effect on Sound	Threshold in Db.	Pressure Increase in cm. water	Effect on Sound	Pressure Decrease in cm. water	Effect on Sound	Threshold in Db.	Pressure Increase in cm. water	Effect on Sound	Pressure Decrease in cm. water	Effect on Sound
1	25	30	60	0	60	0	55	60	0	60	0	Not Heard				
2	0	55	40	0	40	0	10	40	0	40	0	60	20	-	10	+
3	-5	50	40	0	40	0	20	40	0	40	0	65	40	-	40	-
4	10	45	60	0	60	0	20	60	0	60	0	35	40	-	40	-
5	5	35	60	0	60	0	15	60	0	60	0	40	40	-	40	-
6	5	50	60	0	60	0	10	60	0	60	0	40	60	0	60	0
7	15	30	40	0	40	0	40	60	-	60	0					
8	10	30	60	0	60	0	45	60	?	60	0	Not Heard				
9	15	55	60	0	60	0	55	60	0	60	0	Not Heard				
10	10	40	60	0	60	0	45	40	0	40	0	Not Heard				
11	10	35	60	0	60	0	50	60	0	60	0	Not Heard				
12	0	40	60	0	60	0	-10	60	-	60	-	55	40	-	40	0
13	-10	35	60	0	60	0	0	60	+	60	0					
14	25	30	60	0	60	0	15	60	0	60	0					
15	35	45	60	0	60	0	10	60	0	60	0					

TABLE II—GROUP II

Ear Number	Audiogram Type (Table I)	DB BC > AC 256	DB BC > AC 1024	DB BC > AC 4096	Total DB BC > AC 256, 1024, 4096	128 Air					256 Bone					1024 Air				
						Threshold in Db.	Pressure Increase in cm. water	Effect on Sound	Pressure Decrease in cm. water	Effect on Sound	Threshold in Db.	DB BC > AC 256	Pressure Increase in cm. water	Effect on Sound	Pressure Decrease in cm. water	Effect on Sound	Threshold in Db.	Pressure Increase in cm. water	Effect on Sound	Pressure Decrease in cm. water	Effect on Sound
16	1	50	40	40	130	40	40	0	40	-	-10	50	40	0	40	0	45	40	-	40	0
17	1	10	20	10	40	10	20	-	20	0	0	10	20	-	20	-	15	20	-	20	+
18	1	10	15	5	30	10	20	-	20	0	0	10	20	-	20	-	10	20	-	20	+
19	1	20	30	30	80	10	40	-	40	-	-10	20	40	0	40	0	25	40	-	40	-
20	1	15	15	10	40	5	40	-	40	+	-10	15	40	-	40	-	5	40	-	40	+
21	1	5	20	10	35	15	20	-	20	-	15	5	40	±	40	±	45	20	-	20	-
22	1	10	5	0	15	15	40	-	40	-	5	10	20	-	20	-	5	20	-	40	-
23	2	-5	-5	-5	-15	5	40	0	40	0	5	-5	40	-	40	-	-5	20	-	40	+
24	1	25	25	10	60	20	20	-	20	+	-10	25	60	0	20	+	20	20	+	30	+
25	1	10	5	5	20						-5	10	60	0	50	-					
26	1	15	10	10	35						10	15	40	-	40	-					
27	1	10	10	5	25						-5	10	40	-	40	-					
28	1	0	5	15	20						5	0			60	-					
29	1	30	25	0	55						10	30			20	-					
30	1	0	0	5	5						10	0			20	+					
31	8	-5	5	15	15						10	-5			20	-					
32	8	-5	25	20	40	10	40	-	40	-	-10	-5	40	-	40	-	55	10	-	10	-

TABLE II—GROUP II—(Continued)

Ear Number	1024 Bone						8192 Bone					9747 Air				
	Threshold in Db.	DB BC > AC 1024	Pressure Increase in cm. water	Effect on Sound	Pressure Decrease in cm. water	Effect on Sound	Threshold in Db.	Pressure Increase in cm. water	Effect on Sound	Pressure Decrease in cm. water	Effect on Sound	Threshold in Db.	Pressure Increase in cm. water	Effect on Sound	Pressure Decrease in cm. water	Effect on Sound
16	5	40	40	0	40	-	-15	40	0	40	-	60	40	+		
17	-5	20	20	-	20	-	5	20	-	20	-	10	20	-	20	+
18	-5	15	20	-	20	-	5	40	0	40	0	10	20	-	20	+
19	-5	30	60	0	40	-	10	40	-	40	-	20	40	-	40	-
20	-10	15	40	-	40	-	10	60	0	60	0	30	40	-	40	+
21	25	20	40	0	40	0	35	40	0	40	0	55	20	-	20	-
22	0	5	40	-	40	-	35	40	0	40	-	10	40	-	40	-
23	0	-5	40	0	40	0	0	40	0	40	0	10	40	0	40	0
24	-5	25	20	-	40	-	10	40	+	60	0	30	20	+	20	+
25	-10	5	40	-	40	-	5	60	0	60	0					
26	15	10	40	-	40	-	55	40	-	40	0					
27	-10	10	40	-	40	-	45	40	0	40	0					
28	-10	5			60	0	5			60	-					
29	15	25			20	-	20			20	+					
30	0	0			20	+	20			60	0					
31	-5	5			20	-	10			60	-					
32	30	25	60	0	60	0	40	60	0	60	0	55	40	0	40	0

TABLE III—PRESSURE TESTS ON 8 FENESTRATED EARS

Ear Number	Audiogram Type (Table I)	DB BC > AC 256	DB BC > AC 1024	DB BC > AC 4096	Total DB BC > AC 256, 1024, 4096	1024 Air					1024 Bone						Vertigo			
						Threshold in Db.	Pressure Increase in cm. water	Effect on Sound	Pressure Decrease in cm. water	Effect on Sound	Threshold in Db.	DB BC > AC 1024	Pressure Increase in cm. water	Effect on Sound	Pressure Decrease in cm. water	Effect on Sound	Pressure Increase in cm. water	Degree of Vertigo	Pressure Decrease in cm. water	Degree of Vertigo
1	1					35	40	0	40	0	-10		40	0	40	0	40	+	40	+
2	1	5	20	25	50	20	20	0	40	0	-10	20	20	0	40	0	20	+++	40	+++
3	1	35	30	15	80	35	40	0	40	0	-5	30	40	0	40	0	40	0	40	0
4	1	50	60	50	160	75	20	0	20	0	20	60	40	0	40	0	40	0	40	0
5	1	45	15	15	75	45	40	0	40	0	0	15	40	0	40	0	40	0	40	0
6	1	55	30	15	100	65	20	0	20	0	15	30	20	0	20	0	20	0	20	0
7	1	45	45	35	125	70	40	-	40	-	15	45	40	0	40	0	40	0	40	0
8																	40	0	40	0

The effects of air pressure change on the hearing and equilibrium of 8 fenestrated ears are recorded in Table III.

Tests have been made at 1024 cycles with a limited pressure variation. Vertigo was observed with pressure change in two ears and is summarized in a separate column. Basic audiogram type and "intensity differential" data are also included.

KEY TO TABLES II AND III

128 Air, 256 Bone, 1024 Air, 1024 Bone, 8192 Bone, and 9747 Air= audiometric frequency and method at which barometric test was performed.

DB BC > AC 256 the "intensity differential" at 256 = decibels that bone conduction threshold is greater than air conduction threshold at 256.

DB BC > AC 1024 — the "intensity differential" at 1024.

DB BC > AC 4096 — the "intensity differential" at 4096.

Total DB BC > AC 256, 1024, and 4096 — total "intensity differential" = sum of three previous figures.

Threshold in Db. = Decibel threshold of sound stimulus.

Pressure Increase = Pressure increase in centimeters of water that produced effect recorded in next Effect on Sound column.

Effect on Sound = Effect on threshold sound with pressure change.
O = No effect—sound remains constant with pressure change.
+ = Sound intensity increases with pressure change.
− = Sound intensity decreases with pressure change.
± = Sound intensity variable with pressure change.

Pressure Decrease = Pressure decrease in centimeters of water that produced effect recorded in next Effect on Sound column.

Not Heard = Threshold not obtained with maximum power of audiometer.

Degree of Vertigo = + = mild, ++ = moderate, +++ = severe (nausea and vomiting).

SCATTERGRAMS

Groups I and II of Table II have widely different "intensity differentials" (the decibel difference between bone conduction and air conduction thresholds). This difference is graphically portrayed by the scattergrams.

There is a sharp transition between the two groups at 30 decibels of "intensity differential" in the 256 and 1024 scattergrams. This may indicate a stapes fixation.

KEY TO SCATTERGRAM

DB BC > AC 256 = The "intensity differential" between bone conduction and air conduction at 256.

DB BC > AC 1024 = The "intensity differential" at 1024.

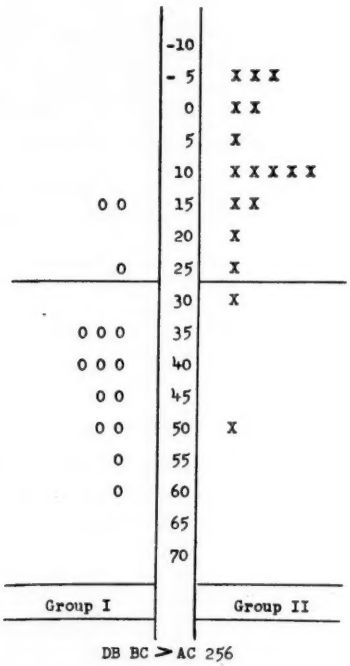
Total DB BC > AC = Total decibels "intensity differential" for 256, 1024, and 4096.

O—Group I = Ears showing no change in bone conducted sound at threshold at *both* 256 *and* 1024 with both positive *and* negative air pressure change.

X—Group II = Ears showing change in bone conducted sound at *either* 256 *or* 1024 with positive *or* negative air pressure change.

SCATTERGRAM I

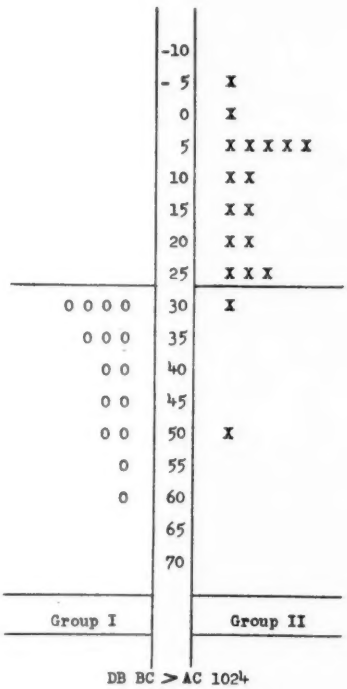
The distribution of Groups I and II according to "intensity differential" at 256 cycles.



(Intensity differential 256)

SCATTERGRAM II

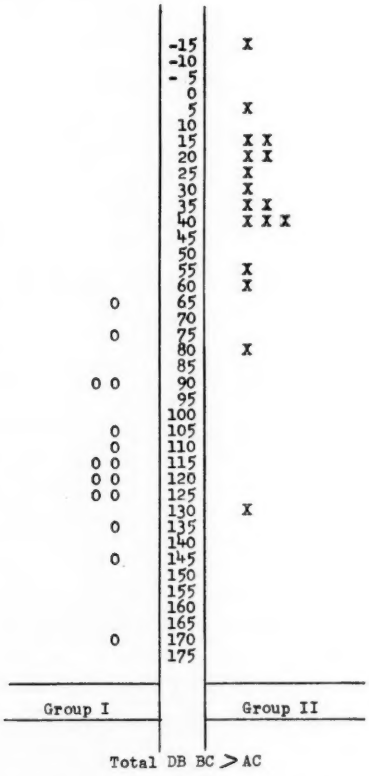
The distribution of Groups I and II according to "intensity differential" at 1024 cyles.



(Intensity differential 1024)

SCATTERGRAM III

The distribu.ion of Groups I and II according to the total "intensity differential" for 256, 1024, and 4096.



(Intensity differential 256, 1024, and 4096)

XXXI

A STATISTICAL STUDY OF INCAPACITATING HEARING IMPAIRMENT IN 1000 CLINIC PATIENTS

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During the years 1947-48, we processed 1000 deafness cases for rehabilitation by means of hearing aids. The accumulated data concerning these patients form the basis for this study, which constitutes an audiologic survey of the deafness problem in the white population of Philadelphia and its neighboring communities. Moreover, the probabilities are that a cross section of the handicapped hard of hearing in other industrial cities in the temperate zone would parallel our findings. The general population harbors generations of people who can trace their hearing impairments to aural infections of the prechemotherapy days and acoustic trauma of the iron age and two great wars. In the majority of cases, however, the hearing defects are in keeping with the natural history of the wear and tear of life and hereditary predispositions. These groups include most perceptive deafness cases, arteriosclerotics and otosclerotics.

The older statistics deal with institutional deafness and they cover the hearing impairments of congenital origin or the kind that is acquired early in life. Some statistical data concerning hearing defects in the military personnel of the wars are to be found in the reports of the armies and navies of the great nations. In the National Health Survey of 1935-36, 2,800,000 persons in 19 states were interviewed in regard to their acuity of hearing. The figures obtained refer only to the hearing difficulty of the individuals. In 1.3%, the deficiency was slight; the "partially deaf" group comprised 1.2%; the "totally deaf," 0.5%. Beasley[1] elaborated on the relationship between the individual's economic state, sex and age and the incidence of hearing impairment. As regards the etiologic laws

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of averages concerning the man who walks the streets, our study is the first attempt at supplying figures with a statistical significance.

Institutional cases and total deafness problems that were studied at our clinics were excluded from this statistical survey. We are concerned only with the individual who can hear speech when loud enough and distinct enough. He comes to the clinic for help when his difficulty begins to cause him embarrassment. An audiologic study of a large number of these patients must throw some light on the progression of the more common otologic entities and frequency of occurrence of certain neurologic conditions which bring about a deterioration of the hearing function. We were unable to attract patients of the negro race in large numbers. The few negroes who visited us presented no features of significance in the consideration of race factors. We therefore preferred to set the charts of this group aside for a future statistical study when more data become available.

As the diagnosis of each case constitutes the prerequisite for classification, the history, medical, neurological and otoscopic findings were scrutinized in addition to the audiologic study, which consisted of audiometry, tuning forks, speech hearing tests and the observation of the patient's speech and his reactions to sound stimuli. The diagnostic criteria thus obtained enabled us to classify a hearing defect into one of the major otologic entities.

Perceptive deafness is characterized by a greater loss for the high frequency tones, poor bone conduction and the presence of the recruitment phenomenon of Fowler.[2] In otosclerosis, there is frequently a history of deafness in the family and the disease is progressive in nature. Usually, one ear is involved to a greater degree than the other. The audiometric pattern is characteristic with practically a uniform loss for all tones by air conduction and comparatively good hearing by bone conduction. The Rinne test is negative; the patient speaks softly and his voice is well modulated; amplification is well tolerated and is most useful towards rehabilitation of the individual. Conductive deafness as a chronic nonprogressive otologic entity is seen in middle ear disease. The drums are thickened, retracted and frequently show scars of healed perforations. Handicapping deafness ensues only when the hearing loss is severe bilaterally and this is encountered rather infrequently. The audiometric pattern consists of a greater impairment for the low tones and good bone conduction. Mixed deafness gives a characteristic audiometric pattern. By air conduction there is a greater loss for the high frequency sounds, while the transmission of low tones by bone conduction is well retained. The otoscopic picture usually consists of

a perforation in the drum with thickening of the inner wall of the middle ear. Bands of adhesions between the intra-aural structures are frequently present, and in a small percentage of cases there is also a chronic discharge. Ménière's disease is the most common neurologic condition which gives a unique form of deafness. One ear is usually affected. Immediately following the vertiginous attack, the hearing impairment is severe and the high tones are involved to a greater degree. With the cessation of the attack, improvement in hearing takes place as the weeks go on. On the succeeding attack, the audiogram shows a greater loss, usually, than that which was present in the previous episode. With repeated attacks, deterioration of hearing sometimes progresses to total deafness. In acoustic neuroma, symptoms referable to other cranial nerves, notably the fifth, frequently precede the onset of deafness which is of the perceptive type. Brain tumors seldom give a severe hearing impairment except when the lesion is located in the midbrain. In the latter instance, total deafness ensues and thalamic and hypothalamic symptoms predominate. A severe form of perceptive deafness is present occasionally in a cerebral palsy child. The patient shows the characteristic athetotic movements. Hysterical deafness is seen in civilian practice rather infrequently. The tell-tale evidence is the inconsistencies of the patient's responses as regards all studies—audiometric, tuning forks and speech hearing tests. A positive Doerfler-Stewart test is frequently obtained.

In our series of cases, otosclerosis is the etiologic factor in about 16.9% of the handicapped hard of hearing in the white population. As indicated by the anatomic studies of Guild,[3] the labyrinthine capsule presents an otosclerotic focus in a far greater percentage of the population. He found an otosclerotic focus in about 4% of the labyrinths of persons over five years of age in a series of 1161 routine autopsies. Guild, however, pointed out the fact that the focus may be found anywhere on the labyrinthine capsule and not necessarily at the region of the oval window. Moreover, even if the fenestra ovalis is involved, each individual activation of the otosclerotic process does not produce enough plexiform bone to bring about fixation of the stapes. Our statistical table shows that otosclerosis precipitates a deafness problem before the third decade rather infrequently. The progression in this disease is slow and it takes repeated outbursts of activation of the otosclerotic process to bring about stapedial ankylosis. In the older age bracket, many patients date back their deafness to an earlier period of life, while others maintain that their difficulty is of recent occurrence. We have substantiated the fact that the activation of an otosclerotic process dur-

AGE GROUP	PERCEPTIVE		CONDUCTIVE		MIXED		OTO-SCLEROTIC		NEUROLOGIC		PSYCHOGENIC	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
5-10	.9	1.3	.2	.1		.1	.1	.2	.1 Athetotic	.1 Athetotic		
11-20	1.7	.7	.1	.1	.6	.3	.1	.2	.1 Athetotic			
21-30	1.6	1.2	.4		.7	.2	.7	2.5		.1 Ménière		
31-40	1.5	2.6		.3	.7	1.5	.6	2.8		.1 Acoustic Neuroma		.1
41-50	3.	3.7	.1	.1	.8	1.7	1.2	1.9		.1 Retrolaby-rinthine Lesion		
51-60	4.5	6.4	.2	.2	1.2	2.	1.3	2.4	.2 Ménière		.1	
61-70	7.1	8.2			1.3	1.6	.5	1.4				.1
71 and over	9.3	12.5			.9	.4	.3	.7				
TOTAL	29.6	36.6	1.0	.8	6.2	7.8	4.8	12.1	.4	.4	.1	.2

Fig. 1.—Percentage distribution of handicapping hearing impairment by age and sex according to etiology in 1000 consecutive clinic patients (white).

ing the menopausal period often leaves the patient with a very severe hearing loss. In our series, 66 of the otosclerotic were 51 years of age or older. This leaves 103 in the younger group. About a half of the latter number could not be considered suitable candidates for the fenestration operation because of a complicated audiologic pattern or because of a medical or psychological contra-indication. At best, the window operation could be offered to 50 of our 1000 handicapped hard of hearing.

The type of hearing loss classified audiologically as mixed deafness constituted 14% in our series of cases. From our study it is evident that a defect in the neural mechanism of hearing is most frequently the cause of handicapping hearing impairment in the general population; 66.2% of our cases belong to this class. By far, the diagnosis of perceptive hearing impairment was most common in the older age groups. The wear and tear of life, acoustic trauma and infections constitute the etiologic factors most frequently. Conductive deafness of a handicapping degree is encountered rather infrequently. Aero-otitis and acute upper respiratory infections are the factors in the blockage of the eustachian tubes and impedance to sound transmission through the middle ear. Therapy is most effective in the acute phase. In the chronic form, the patient seldom requires a hearing aid as a severe bilateral hearing loss is rarely present. Only 0.3% of our patients presented the true form of hysterical deafness. However, a psychogenic overlay on an organic type of deafness is encountered rather frequently. This fact was emphasized by Hardy.[4] A neurologic lesion was the cause of deafness in less than 1% in our series.

SUMMARY

1. An abnormality of the perceptive mechanism is the etiologic factor in most cases of severe hearing impairment—66.2%. The predominance of women over men in this otologic entity is probably due to the greater longevity of the female. In the age group of 71 years and over, there were 125 women to 93 men.

2. Mixed deafness is slightly more prevalent in the female than the male, the ratio being 7.8:6.2.

3. Childhood deafness is most frequently of the perceptive type.

4. A conductive lesion, exclusive of otosclerosis, is seldom the cause of a severe hearing loss.

5. There is a lesser incidence of clinical otosclerosis in the male than in the female. The ratio is 1:3 in the white population.

1923 SPRUCE STREET.

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XXXII

A STUDY OF CILIARY ACTIVITY IN THE RESPIRATORY TRACT OF ANIMALS

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STATEMENT OF PROBLEM

The following is a study of the relation of respiratory ciliary activity of animals to the induced allergic state. It was undertaken because an article by Hilding[1] in 1943 suggested there might be a relation between the two. The literature contains scant information as to what happens to the cilia of the respiratory tract during an acute allergic attack. To this end, it seemed worth while to observe the cilia of the experimentally sensitized animal for any departure from normal ciliary activity at the time of the introduction of the antigen, either locally at the site of the cilia under observation or parenterally. Such a situation would be analogous to an allergic person who either inhaled or ingested an allergen, producing an acute allergic attack with possible abnormality of function of the cilia.

CILIARY ACTIVITY IN THE INDUCED ALLERGIC STATE

REVIEW OF THE LITERATURE

Definition. A ciliated cell is a nucleated cell distinguished primarily by a motile whip-like extension at some point on the free surface of the cell wall. There usually is more than one cilium on each cell.

Historical. Cilia were discovered by Anton de Heide in 1683 and also were described in Arcana Naturae 12 years later by Leeuwenhoek. St. Clair Thomson[4] refers to Purkinje and Valentin as first describing the cilia in mammals. It was 150 years after Anton de Heide's description of the cilia before Sharpey[5] contributed the next

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important addition to the knowledge when he described the movement of the inundating water at various points on the body surfaces of larvae of frogs and newts, Mollusca and other invertebrate animals. On examining the gill of tadpoles with a "powerful lens," Sharpey saw "that it was beset with minute cilia, which are evidently instrumental in producing the different currents." Another period of silence followed until the late nineteenth and early twentieth centuries when Saguchi,[6] Bütschli[7] and others became interested. In 1928 Gray[8] in London and McDonald[9] working with Leisure in the United States stimulated further thought on the subject by their investigations. Hilding, Lucas, Proetz and others, to whom reference is made below, have more recently made contributions.

Embryology. Embryologically, cilia are very old structures in the history of animal life, being encountered in primitive unicellular organisms and probably throughout the more complex members of the animal kingdom with the exception of the nematodes and typical arthropods.[8] They are derived from all three germ layers, ectoderm, mesoderm and entoderm.[8]

Location. In man, ciliated epithelial cells are found in the fallopian tubes, kidney tubules, vasa efferentia, paranasal sinuses, most of the middle ear, the eustachian tubes, and throughout the respiratory tract except for the anterior one-third of the nose, the posterior mesopharyngeal wall, portions of the larynx and the terminal ramifications of the bronchial tree. In the respiratory tract the cilia act in such a way as to propel the overlying mucus and other materials in the direction of the pharyngeal end of the esophagus.

Structure. The structure of the cilia in animals has been described by Saguchi.[6] At the superficial portion or distal end (free surface) of a ciliated cell, there is a narrow band of differentiated protoplasm, the so-called cuticular border, and from this area the cilia take origin. The cilia are implanted into the cuticular border by what appears to be a series of rootlets or thread-like structures which run from the shaft of the cilium down to the cell body, at which point they are lost in the protoplasm. There is considerable question whether the cilia actually pass through the cuticular border or not. At the proximal (basal) end of each cilium are the minute granular or rod-like basal bodies and the ciliary rootlets apparently take origin from these bodies. The basal bodies stain black with iron hematoxylin and are always present, but their exact size, shape, and position vary. The remainder of the cell is occupied by the cell protoplasm in which the nucleus is found. The system of diverging

rootlets may be the pathways by which the activity of groups of cilia are co-ordinated.[10]

Proetz[11] states that in the human respiratory tract the average dimensions of a single cilium are 7 microns in length by less than 0.3 of a micron in diameter, i.e., the length of a cilium is about equal to the diameter of a human red blood cell. The simplest vibratile organ attached to the cell wall in the manner of a cilium is a flagellum of which there usually are two to four to a cell and which usually are of larger dimensions than a cilium. Lucas[10] found 8.5 cilia on the surface of a cell 6.2 microns in diameter.

Mode of Action. There is virtually no unanimity of opinion as to the detailed structure of the cilium itself or its subservient mode of action. Most writers do not consider the cilium a hollow shaft but rather a projection of the cell protoplasm. However, Schafer[12] in 1911 reasoned that if the shaft of the cilium were a hollow extension of the cell itself then rhythmic contractions of the cell would alternately distend and collapse the cilium and thus impart motion to it. Practical observation and careful microscopic analysis of the structure have not confirmed this theoretical explanation. Gray[13] states that the vibratile elements show no optical structure even under polarized or transmitted light. Some workers[14] thought there was an "elastic" rod-like center to the cilium which caused it to return to its original position once having been bent by some object. Heidenhain[14] attributes the motion of the cilium to alternate contractions and relaxations of one side of the superficial layers of the shaft of the cilium. To bring the cilium back to the original starting position, in this case, a central core or opposite side of greater rigidity than the contractile side would be necessary. These theories do not explain why, with no stimulating object (unless the illuminating rays are in themselves stimulating), cilia are frequently observed to beat for many hours. Nor does it explain the phenomenon of polarity as mentioned below.[15]

Perhaps the fundamental question is whether the role of the cilium in the ciliary cycle is active or passive. Objections can be raised to all the explanations, such as those given above, in which the part of the cilium is passive. It is not the intent to go further into this argument except to state that Gray,[8, 13] adapting a theory of Hill and Hartree for muscle motility, believes that the ciliary movement is caused by the distribution of water molecules within the cilium. At rest, the water molecules are evenly distributed across the whole section. However, one side of the cilium *acquires* an af-

finity for water, thereby causing the water to become concentrated in that portion. The side containing an excess of water expands, the other contracts and the cilium is bent. Relaxation occurs when the affinity for water is lost and the water molecules are again evenly distributed. Gray believes that the "essential change in the affinity for water may well be due to a modification in the degree of ionization of a protein or similar molecule: thus the localized production of an acid would produce this effect whilst the neutralization of the acid would return the system to the status quo."

Ciliary Cycle. The to-and-fro movement of the cilium is called its "beat" or "stroke." In the human, there is a more forceful and faster forward or "effective" stroke and then a less forceful and slower backward or "recovery" stroke. The effective stroke has been estimated to occupy one-third to one-fifth of the time required for a complete cycle. Proetz[16] in 1933 stated: "The time required for a single cycle of motion [of cilia] in both rabbit and man, varied from one-fourth to one-tenth second. This was estimated by counting the film frames of slow motion pictures of known speed." Gray[8] estimates the speed of the beat as follows: "Let the length of a cilium be 10 mu and let it oscillate through an amplitude of 180° twelve times every second; the total distance travelled in one second by the tip of the cilium is therefore 12 [π (10 μ)] = 375 μ (approx.)." Proetz,[11] considering nasal cilia to be about 7.5 microns long and beating 8-12 per second at the normal nasal temperature of 30° C. and using Gray's formula arrived at a lower figure. Furthermore, Proetz believes that in the human nose, the arc traversed is considerably less than 180°.

Speed of Ciliary Beat. The factors controlling the speed and frequency of the ciliary beat have been investigated by Proetz[11] and others. The speed and frequency of the beating varies inversely with the size. For human nasal cilia the normal nasal temperature, as mentioned above, is 30° C. Above 30° C. some increase in rate may occur but complete irreversible cessation occurs in the rabbit at 43° to 44° C. The activity increases, according to Gray,[8] with an increase in pH up to 9 and then falls. Increased acidity decreases the activity. Lommel[17] found that anemia slowed ciliary activity.

Effect of Dryness of Cilia. Cilia are rapidly and irreversibly susceptible to dryness. In fact, a water medium is essential to normal ciliary activity. Proetz[16] in a recent article suggests that localized points of dryness temporarily produced in the human nose by various means may lead to stopping of the ciliary activity which might initi-

ate a deleterious chain of events. As a result of the stasis of the overlying blanket of mucus the virus or bacteria which ordinarily would be removed by the ciliary action by means of the moving blanket of mucus may remain in contact with the nasal epithelium long enough to penetrate the mucosa and cause an infection (coryza). Factors which could lead to the drying of the mucous membrane with resultant ciliary stasis would be such things as an upset of the autonomic nervous system leading to unilateral nasal blockage and hyperventilation on the opposite side, nasal septal defects causing abnormal convection currents, etc.

Speed of Motion of the Blanket of Mucus. The speed of motion of the overlying blanket of mucus has been measured many times by observing the distance travelled in unit time over a measured distance by some refractile substance such as lamp black, sulfonamide powder, carmine red, etc. Lucas[18] has objected to these methods because the solid indicators in themselves may be stimulating. According to Hilding[19] the blanket of mucus in the posterior two-thirds of the human nose may reach a speed of 10 mm. per minute. In the anterior one-third the motion is much slower due to the sparce cilia. Ink injected subpleurally[20] into the lungs of decerebrate cats was carried to the subglottic region in 14 minutes, which involves a straight line course of about 12 cm. A distance greater than this was travelled because the mucus streaming within the trachea and the bronchi is spiral. In this case, the speed of the particle was approximately 10 mm. per minute.

Movement of the Blanket of Mucus. During the "effective" stroke of the cilium, the shaft is stiff and slightly curved forward. The "recovery" stroke is characterized by a relatively limp cilium with a greater curvature. Both strokes are in the same plane and are perpendicular to the long axis of the cilium itself which is a fundamental difference in comparison to a muscle cell. It is the motion of many cilia, acting in concert, which brings about the motion of the overlying blanket of mucus. In vertebrates, the wave progression is in the direction of the recovery stroke (Proetz), that is, the surface stream moves in the direction of the active stroke but the waves as seen through the microscope move in the opposite. This wave in the mucous blanket or "dimple" of Proetz is created by the depressed, relatively limp cilium as it is returning from the full extent of the effective stroke to the position in readiness for the next effective stroke. A remarkable series of ten photographs of the cycle of a single cilium from the abfrontal group of Mytilus is given in Gray's book.[13]

The question of whether the normal state of cilia is one of activity or inactivity is difficult to answer. Lucas and Douglas[21] state that the "normal physiologic base line" of ciliary activity of the palatal cilia of the frog is zero. These cilia can be brought into activity by localized stimuli such as the addition of fluids, even Ringer's solution, or by mechanical means such as drafts of air, carbon particles gently wafted onto the membrane, etc. The cilia of the duck vibrate continuously, however, according to that author.

Co-ordination of Cilia. Cilia do not move in unison across an entire membrane, but rather groups of cilia move in a co-ordinated fashion (metachronism), each group seeming to beat independently of neighboring groups. The groups are microscopic in size, and are indicated by the dimples in the mucous coat as seen through the microscope. The nature of the nervous control which leads to the co-ordinated activity of the cilia within each group is another unsolved question. Lucas,[10] using lamellibranch gill in 1931, concluded that a nervous impulse passes through the cytoplasm of the cell and that the system of diverging rootlets in the laterofrontal cells carries the impulse simultaneously to all the cilia within a single cell. Lucas[22] stated in an article on the co-ordination of ciliary movement, using modiolus gill, that "there exists a neuromuscular type of junction [in a ciliated epithelial surface] across which the impulse passes when the two bodies may be the locus of the neuromuscular connection."

The exact source within the individual cell of the movement of the cilia of that cell is a much discussed point. Peter[23] in 1899 was the first to show that when a ciliated protozoan is crushed into small fragments ciliary activity continues as long as there is organic connection with a fragment of the cytoplasm. Ehrhard[24] and Gray[25] have demonstrated that profound changes in the proximal cytoplasm and nucleus can occur without entailing a cessation of the ciliary movement.

According to Engelmann[26] enucleated spermatozoa exhibit active movement. There is, then, according to Gray,[13] "general agreement that the whole of the essential ciliary mechanism lies at the distal end of the cell." Many authors including Peter,[23] Gray,[13] and Saguchi[6] also believe that the basal granules located in the distal margin of the cell protoplasm are the kinetic centers of the ciliary activity.

Nervous Control of Cilia. Some work has been done on the subject of the nervous control of the cilia by McDonald et al.[9] These authors reported that in the living frog the rate of transport of a

small cellulose particle by the cilia of the mouth or pharynx was increased 100% when the sympathetic nerve was stimulated. A corresponding decrease was noted after stimulation of the parasympathetic nerve and similar effects were noted after the injection of the sympatho- and parasympathomimetic drugs. The precise dosage of the drugs injected in the latter case was not given.

Lucas and Douglas,[21] using turtles and observing the cilia of the tracheal mucous membrane in vivo by means of direct examination through a microscope, found no change in ciliary rate following the "injection of pilocarpine, epinephrine, atropine, morphine, or alcohol, nor did electrical stimulation of the vagus or the tracheal tissue produce any effect." The authors suggested that stimulation of the motor nerves to the trachea does not effect the rate of ciliary activity but rather the composition of the overlying blanket of mucus, thus producing a more or a less readily transported material. Lucas[18, 21] pointed out that even small foreign bodies applied to a mucous membrane are stimulatory to the cilia. The work of McDonald et al. mentioned above employed such a solid indicator.

Polarity. That the cilia of an excised strip of mucous membrane can beat for many hours when existing in a suitable medium although entirely apart from any central nervous control has been observed many times. The cilia of an excised strip of mucous membrane always retain their polarity regardless of how regrafted.

Comparison of Muscle and Ciliated Cells. Gray[8] and others have drawn many parallels between the activity of muscle and ciliated cells. The most striking parallel is found when comparison is made to the heart muscle. Both cells can continue to evidence their activity when entirely extirpated from the body if they are kept in a suitable environment, both are relatively indefatigable and both exhibit a type of local neuromuscular control. An important difference, Gray points out, is that the action of the heart muscle cell is parallel to the long axis of the cell body whereas in the ciliated cell it is perpendicular. The separate effects of temperature and hydrogen ion concentration are the same on the two types of cells. In the absence of calcium, cilia come to rest in the same manner as cardiac muscle although there is no diminution of oxygen consumption.[8]

Both muscle and ciliated cells continue to be active in the absence of oxygen, though less efficiently than in the presence of the gas. Both Gray[8] and Engelmann[27] found that the ciliated epithelium of the frog continued to beat for two hours in an atmosphere

of hydrogen. The cilia in this case could be returned to normal by introducing oxygen. Gray used Mytilus and found the cilia moved about 30-45 minutes in the absence of oxygen and that the recovery was slow. A similar period (30-45 minutes) in ciliary activity was noted by the same author after deprivation of oxygen by means of high concentrations of cyanides (0.1% NaCl) in sea water bathing the cells. Gray ended: "We can conclude therefore that ciliated cells like muscles . . . can perform their functions anaerobically but that oxygen is necessary for prolonged activity."

That ciliated cells have it within their potentiality to undergo transformation into glandular and columnar cells was described by Saguchi.[6] He quotes many authors on this point. Sternberg[39] also describes the change of ciliated cells to goblet cells, depending on the physiologic need of the animal for one type cell or the other. Hilding[29] has noted the increase in goblet cells in rabbits' and dogs' noses experimentally obstructed on one side at the expense of the ciliated cells. On the opposite control side no change was noted.

Functions. The functions of the ciliated cells have to a large extent already been considered. Originally in unicellular organisms (paramecium), the animal's motive power came from the activity of the cilia. In larger animals other means of propulsion are used. The cilia, instead, propel food into the oral cavity and thence on down the digestive tract. In a similar manner, the cilia of some animals function to expel waste from the body or repel noxious substances from nearing the body surface.

Mucus Streaming. In the human, the cilia of the bronchi, trachea, nose, sinuses and nasopharynx are constantly covered with a thin, slippery, tenacious "blanket" of mucus which is probably kept moving constantly by the underlying cilia toward the pharyngeal orifice of the esophagus. In the bronchi and trachea, the movement is in a whorl (clockwise) direction as viewed from above and, in the posterior two-thirds of the nose, more or less directly backward toward the nasopharynx, dividing above and below the orifice of the eustachian tube. Hilding[19] points out that practically all the drainage from the anterior one-third of the lateral wall of the nose passes through the middle and inferior meatuses. The blanket of mucus entraps a considerable amount of foreign material which gets past the barrier of the nasal vibrissae and is removed along the blanket of mucus. The mucous coat of the posterior two-thirds of the nose is probably renewed every ten minutes approximately, that of the

sinuses every twenty minutes, and that of the anterior one-third of the nasal cavity every hour or so.

Vacuum Produced by Ciliary Action. In recent years, Hilding has done considerable work on the functions of the cilia. In 1943, he began a series of experiments[1, 2, 3, 28] of great interest. First he reported how a mass of mucus (removed from hens), placed at the inferior end of excised hen's trachea in such a manner that it occluded the lumen, was moved by ciliary action toward the laryngeal end. A water manometer inserted behind the occluding diaphragm of mucus recorded a negative pressure of 35-36 mm. When the manometer was placed at the laryngeal end a positive pressure was recorded. In another experiment, an occluding mass of mucus (taken from dogs) was placed over the nasofrontal duct of a dog's frontal sinus and a water manometer was connected by a needle through the anterior wall of the sinus. As the mucus plug was moved down the nasofrontal duct by the activity of the cilia no air entered to occupy the additional space thus provided and a relative vacuum was registered in the manometer. On the control sinus, the water manometer recorded no change in intrasinus pressure. In order to obviate the possibility of blood absorption of the air the experiment was repeated with the sinus of a decaptitated dog and in an exsanguinated animal with similar results. By this method vacuums of 40-50 mm. of water were produced. By analogy Hilding wondered if "vacuum otitis media" could not thus be created. In the postoperative state after any of the various anesthetic agents, it is not uncommon to have an excessive amount of viscous mucus formed in the lower bronchial tree. Hilding wondered if the removal of this mucus by ciliary action, with negative pressures being created in a manner analogous to those described, might not be a partial explanation of the development of a postoperative atelectasis.

The effects on ciliary activity of the various gases and liquid drugs in direct contact with the cilia of normal animals have been investigated by Proetz,[11] Lierle,[30] and Crally[31] and will not be repeated in detail.

Very little has been written of the effect on cilia of acute allergic states. Ornston,[32] using humans, followed the intranasal streaming of microcrystals of sulfathiazole which he had placed in the nose. In making a qualitative comparison between individuals of the speed with which the crystals moved in clinically allergic and nonallergic cases, no difference was noted. A similar experiment was done on humans by Tremble.[38]

Harrison,[33] working with Paramecium bursaria, sensitized these one-celled animals to rabbit serum. Then, on exposing the paramecia to the allergen, he noted that an envelope slowly formed about the bodies of the animals and that the cilia, which had been freely active before the introduction of the antigen, became intertwined in the envelope and slowly came to rest. Proetz[34] in remarking on this experiment, noted that, "At least in the early initial stages the activity of the cilia beneath the envelope was in no way diminished."

Hilding[1] in 1943 reviewed a series of 39 fatal cases of asthma. Seven of these were omitted because of unsatisfactory slides. Of the remaining cases, 12 showed a metamorphosis from ciliated cells to mucus producing cells. As a result of the metamorphosis, Hilding believed that not only an additional amount of viscid mucus was produced in the bronchi but that the loss of the ciliary mechanism might be the essential first step leading to stasis of the mucinous and bacterial debris in the bronchi, and ultimately death.

METHODS AND MATERIALS

Methods. In general, the methods used to investigate ciliary activity can be divided into three groups: (a) Those employing solid indicators, (b) direct observation of the cilia, and (c) the production of a vacuum by ciliary action. In all of these methods, it is necessary to maintain a high humidity in the environment surrounding the specimen. Dryness leads to a rapid slowing of the ciliary beat and consequent inaccuracy of the observations. Thus, any method of investigation must be done quickly (a matter of minutes) before dryness supervenes unless adequate provision has been made for maintenance of the necessary humidity. In the latter case, this would probably require an environment of 100% humidity at the normal body temperature of the animal or specimen under investigation.

The first method, that employing solid indicators, has probably been the most commonly used and is relatively less difficult than the others. A suitable ciliated surface is chosen, such as the posterior pharyngeal wall of the intact frog or an excised strip of ciliated mucous membrane. On this specimen an opaque indicator, such as a fleck of lamp black, is gently wafted onto the membrane or a light piece of cork is placed and its speed of propagation is measured as it is moved by ciliary action.

Objections to this method can be raised on two main counts. First it is necessary to maintain an intact "blanket of mucus" over

the cilia themselves for efficient transport of the indicator by ciliary action. Thus, if between successive examinations, irrigation or otherwise, cleansing of the specimen is necessary, the mucous layer is changed with resultant decrease in accuracy of the observations. Lucas[18] has pointed out that the solid indicators in themselves may be stimulating and so it is necessary to avoid this stimulating effect wherever possible or use the same indicator as a constant factor in each examination.

A variation of this method, developed by Inchley,[35] consisted of excising a strip of ciliated mucous membrane, fixing the two ends but leaving the middle portion lax so that a sling-like arrangement of the membrane was produced. He applied a small glass rod to the depth of this sling. The rod was fixed at one end but in such a fashion that rotation on its long axis was possible. The ciliary action was manifested by rotation of the glass rod. There are many objections to this method; first, adequate moisture must be maintained; second, there probably would be a significant variation in the number of cilia in contact with the glass rod at any one time, depending on the width of the strip; and third, the load is relatively large compared with the usual foreign body the cilia might be called upon to transport.

The second method of direct observation of the mucous blanket overlying the cilia was pioneered by Lucas, Proetz, and others. Either the intact animal or an excised strip of ciliated mucous membrane can be used. The source of illumination is directed onto the specimen from a nearby bulb or the light, as in the ultropak microscope, may be incorporated in the barrel of the microscope itself. This has the advantage of producing a light which is parallel, or very nearly so, to the visual axis of the eye and thus does away with shadows. If the excised specimen is used, the former is satisfactory, but if an intact animal is employed the latter is necessary. The ultropak microscope has the additional advantage of conducting the light through a quartz ocular which provides a relatively "cold" light and there is thus less danger of excessive heat and drying.

Dryness. Combatting dryness is one of the main difficulties with this method because of the proximity of the light source. The higher magnification ($\times 50$) is both a disadvantage and an advantage. It is a disadvantage because of the short focal length involved (approximately 1 cm.). Thus, any motion of the animal may cause the specimen to rub against the ocular, destroying the accuracy of the preparation. The high magnification is of much value because the

activity of the cilia can be directly examined without an indicator and a more accurate idea of its vigor obtained. Likewise, various fluids can be observed as they flow over the ciliated surface and any immediate effects on the ciliary activity observed. The method is of less value for studying chronic effects.

The third method in which a vacuum is created by ciliary action was proposed recently by Hilding.[1, 2, 3, 28] He excised a hen's trachea and at the inferior end placed an occluding diaphragm of mucus collected from the tracheae of other hens. As this mass was moved toward the pharyngeal end of the trachea by ciliary action, the vacuum produced was measured by a water manometer placed in the trachea inferior to the occluding mass of mucus. This method is less wieldy than the others. If an intact animal is used, there is always the possibility of the flowing blood absorbing some of the constituents of the air and thus producing a partial vacuum. Direct observation of the cilia is impossible with this method.

The principle objection to all the methods in which an extirpated specimen of ciliated mucous membrane is used is that the reactions would not correspond to those of the cilia in an intact animal. However, Proetz[36] states, "So far no significant discrepancies have arisen between the two [extirpated human ciliated specimens and living animal specimens] in the nature of the effects."

Animals. Female rabbits weighing 3-4 lb. supplied by a commercial sales company were used in the present experiments. Each animal was observed for at least six days and then, if no disease was detected, used experimentally. The animals were divided into two groups: A, normal animals and B, sensitized animals in which the extirpated ciliated mucous membrane was exposed to (1) the allergen or (2) histamine in a stength of 1:1000.

Sensitizaton. Sensitization of the animals was accomplished by a modification of the method suggested by Bally.[37] Subcutaneous injections of 0.5 cc. per kg. of horse serum were given every 5-7 days under the skin of the back or the abdomen. Different sites were used for each injection. Usually after the sixth or ninth injection, an ulcer (Arthus phenomenon) developed and was accepted as a criterion of sensitivity. The extirpated ciliated mucous membrane (usually the trachea) was then subjected to various experimental conditions as described below.

Method Used. In this work, the observations were carried out by a variation of the second method described above. After anes-

thetizing the animal to death with either ether by inhalation or nembutal given intravenously, a specimen of ciliated mucous membrane was extirpated. Most of these specimens were obtained either from the nasal septum or from the trachea which had been cut in sections. The latter method was deemed preferable because of the speed and ease with which the specimens could be excised and examined. After exposing the trachea, hemostats were used to compress it just inferior to the hyoid and as far inferiorly in the thorax as conveniently possible. The trachea was then excised, the specimen placed on a glass slide, the hemostats removed, and the trachea slit lengthwise down its ventral surface. Opening the trachea then brings two folds into prominence along the posterior surface at the posterior extremity on either side of the cartilaginous ring. It is on these folds that the cilia in "profile" can be viewed readily through the ultropak microscope. Various transverse sections are then made to produce specimens 10-12 mm. long. These specimens, after being observed quickly for vigorous ciliary activity, are placed in various test solutions for a measured length of time and then reexamined for the quality of the ciliary activity.

The horse serum was obtained from the Ashe Lockhart, Inc. laboratories of Kansas City, Mo. Sterile precautions were observed in withdrawing serum for use and the stock bottle was kept under refrigeration. The dilutions were all made with 0.85% sodium chloride.

RESULTS

General Observations. Looking through the ultropak microscope on the ciliated surface does not reveal the cilia themselves but rather the overlying blanket of mucus which moves as a result of the ciliary activity. The most striking features are the many dimples or shallow pits produced in the mucous blanket. These dimples are constantly forming, disappearing and being replaced by others. They form as a result of groups of cilia working in unison. The recovery stroke of the ciliary cycle is characterized by a relatively limp cilium somewhat curled on itself. It is during this stage of the ciliary cycle that the shallow pit or dimple is produced in the mucous blanket. Each of the dimples is short lived, lasting only a fraction of a second, and constantly being replaced by another more recently formed dimple in the same location. The dimples all move in the same general direction, but there is no repeated regularity about them. In one microscopic field perhaps seven to eight dimples, each indicating an independent group of active cilia, can be seen. Analogy could not

be made to an ocean wave moving evenly across a large expanse of surface but more to a field of clutching hands viewed from above in which all the hands were moving in the same general direction. The scene is one of furious activity and any decrease in activity is quite apparent to the observer.

From time to time as the ciliated surface is observed, refractile air bubbles or small opaque foreign bodies can be seen to pass through the field. By introducing a fine drawn capillary tube into the field, the mucous blanket can be investigated. On depressing the tube, the blanket can be umbilicated or on exerting gentle suction it can be lifted and traction brought to bear on it. A gentle air blast sent through the tube quickly evaporates the mucous blanket and brings the cilia to irreversible stasis. Gently depositing a small piece of carbon onto the mucous coat results in the foreign body being transported across the microscope field; however, any interference with the integrity of the mucous coat interferes with the efficiency of the transportation. Washing or irrigating the surface with saline or Ringer's solution is sufficient to remove this mucous coat and prevent efficient transportation of air bubbles or other foreign bodies.

Effect of Antigen on Ciliary Activity of Sensitized Animal. Group A, consisting of eleven nonsensitized rabbits, had the excised specimens of the trachea cut into sections as described. One specimen from each animal was placed in 0.85% saline as a control. Of eleven specimens observed for ciliary activity from time to time over a period of 2 to 28 hours, no lessening of activity was noted. Five specimens, after first being observed and found to exhibit vigorous ciliary activity, were immersed in 50% horse serum diluted with 0.85% saline and vigorous ciliary activity was noted 25 to 70 minutes later. Five specimens were also tested in 17% horse serum and undiminished ciliary activity was noted 3½ to 28 hours alter. Thus, it is apparent that with the two more dilute solutions of horse serum, 17% and 10%, there is no acute qualitative decrease in ciliary activity. In the case of the 50% solution, the ciliary motion was appreciably less than the controls, but the factor of lack of isotonicity enters here and influences the result. The results are more clearly shown in Table 1. The + signs indicate that the experiment was terminated at the time in the table. Where no + sign is present, the cilia ceased beating soon after the time indicated.

In Group B, the rabbits had been sensitized to horse serum as evidenced by the development of an Arthus phenomenon. Seven rabbits were included in this group, and the cilia after various pe-

TABLE 1.

Rabbit	0.85% Saline	50% Horse Serum	17% Horse Serum	10% Horse Serum
1	28 hr.+*	33 min.	1⅔ hr.+	28 hr.+
2	4½ hr.+	70 min.+	4 hr.+	3½ hr.+
3	3 hr.+	25 min.	1 hr.+	5 hr.+
4	3⅔ hr.+	40 min.	21 hr.+	18 hr.+
5	18 hr.+	45 min.	19 hr.+	24 hr.+
6	2 hr.+	—	—	
7	2 hr.+	—	—	
8	2 hr.+	—	—	
9	2 hr.+	—	—	
10	2 hr.+	—	—	
11	2 hr.+	—	—	

*The figures indicate the number of hours or minutes at the end of which time ciliary activity was still vigorous.

riods of immersion in the control solution, 0.85% saline, and the three test solutions, were examined periodically for qualitatively vigorous ciliary activity. The test solutions were the same as used in the animals in Group A, namely: 50% horse serum diluted with 0.85% saline, 17% horse serum diluted with 0.85% saline, and 10% horse serum diluted with 0.85% saline. From Table 2 it is clear that introduction of the ciliated specimens from the sensitized animals into the solutions containing the antigen (horse serum) did not cause an acute decrease in ciliary activity. The + signs in Table 2 indicate that the experiments were terminated at this point as only the immediate acute effects on ciliary activity were being investigated. The total length of time the cilia continued to beat vigorously was not charted.

In Group C six rabbits, two nonsensitized and four sensitized to horse serum as evidenced by the development of Arthus phenomenon were used. The procedure differed from that already described inasmuch as the two nonsensitized animals were killed by an overwhelming dose of 1:1000 histamine. The tracheal cilia were immediately examined under the ultropak microscope and vigorous ciliary activity was noted. Four sensitized animals were then killed

TABLE 2.

Rabbit No.	Day Following Arthus Phenom.	50% Horse Serum	17% Horse Serum	10% Horse Serum	0.85% Saline
1	6	2⅙ hr.+	1⅙ hr.+	2 hr.+	2 hr.+
2	8	3 hr.+	3 hr.+	3 hr.+	3 hr.+
3	11	1⅔ hr.+	2 hr.+	2 hr.+	2⅙ hr.+
4	13	1 hr.+	1⅓ hr.+	2½ hr.+	1⅔ hr.+
5	6	—	—		2 hr.+
6	8	—	—		1⅔ hr.+
7	11	—	—		3 hr.+
8	13	—	—		2½ hr.+

as previously described with nembutal given intravenously. After exposing the tracheal cilia, histamine (1:1000) was dropped directly onto the ciliated surface under direct vision through the microscope. Again no qualitative change in the vigor of the ciliary activity was noted (Table 3).

DISCUSSION

The work reported by Hilding[1] on the loss of ciliary function in the lungs of 12 of 39 fatal cases of asthma and the work of Harrison[33] on the loss of ciliary function in the sensitized Paramecium bursaria when the allergen was introduced imply that the activity of the cilia is deleteriously affected by the allergic state. The present investigation does not corroborate that idea. In fact, qualitatively, no slowing or other depression of function was noted in any of the rabbits studied. The method used was such that an increase in activity of the cilia following the introduction of the allergen to the ciliated specimen from a sensitized animal would not have been brought out.

The present work does corroborate that of Ornston[32] and Tremble[38] whose purely clinical comparison of ciliary streaming in allergic and nonallergic nasal mucous membranes indicated that the state of allergy did not depress ciliary function.

TABLE 3.

Animal	Days Following Arthus Phenom.	Effect on Cilia of: Overdose Histamine (1:1000) I.V.	Histamine (1:1000) Directly onto Cilia	0.85% Saline
Rabbit	Not sensitized	No change in ciliary activity	—	—
Rabbit	Not sensitized	No change in ciliary activity	—	—
Rabbit	6	—	No change in ciliary activity	2 hr.
Rabbit	11	—	No change in ciliary activity	1⅔ hr.
Rabbit	11	—	No change in ciliary activity	3 hr.
Rabbit	13	—	No change in ciliary activity	2½ hr.

SUMMARY AND CONCLUSIONS

A general review of the literature on respiratory ciliary activity is given and an attempt made to answer the question of the effect on ciliary activity of the induced allergic state in the rabbit.

No acute qualitative depression in ciliary function in the nonsensitized or sensitized rabbit was observed when the antigen (horse serum) was introduced. The cilia of sensitized and nonsensitized animals were not qualitatively depressed in function by either an overwhelming intravenous dose of 1:1000 histamine or the local application of 1:1000 histamine directly onto the cilia.

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XXXIII

THE EARLY DIAGNOSIS OF PRIMARY CARCINOMA OF THE LUNG

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Some 242 years ago there was born in Forli, Italy, a young anatomist who was to become President of the Academia Inquietorium at the age of 24 years. This man was Giovani Battista Morgagni. Shortly after assuming his position as President of the Academia he urged that his fellows disregard the practice of abstract speculations in favor of exact anatomical observations and reasonings. He saw the need of studying the pathological tissues as well as the normal ones. New trends of thought or changes in procedures bring into the open reactions from the placid and nonconformists. Harvey was in this latter camp, and he countered with the remark that little could be learned from the study of organs regardless of the cause of death.

Morgagni viewed symptoms as, "The cry of the suffering organs." From his writings, many of which were placed in his monument, we learn of his describing lung disease in the form of nodular growths.

This awakening to lung malignancies early in the eighteenth century had its counterpart in 1933 when Graham did the first pneumonectomy in effort to remove this disease entity. Since then, the improved operative procedure and the standardized supportive treatment to prevent shock, together have brightened the gloomy picture of the serious import of lung malignancies.

The early diagnosis of primary carcinoma of the lung has improved over the years but to achieve this end it is necessary for the public to be educated, without undue fear, as to what the early symptoms are and what to do about it. It seems incongruous that it takes the death of some well known person from cancer to propel them

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Candidate's thesis to the American Broncho-Esophagological Association.

to their doctor with a complaint that is suggestive of their having a similar fate in store. Public education about the early symptoms is progressing, though at times it may seem hopeless when we consider the awful gullibility of amethodical people. Recently in a mid-west city some quack invented a celluloid dumb-bell that contained a secret fluid, which when held in the hand for 20 minutes two or three times a day would cure all illnesses by the improvement of "body atomic functions." Before the quack was apprehended he sold 1,000 of them at fifty dollars a piece. Fortunately, this is the exception and not the rule governing the public's eager willingness to fall for "Dumb-bell" ideas. Public awareness to malignancies could be improved through symptom education.

The increased number of reported cases of primary carcinoma of the lung is little short of alarming and calls for added suspicion of the disease and investigation of any cough. If no acid-fast basis is found, and the more common causes of cough have been eliminated, this early symptom should be considered as due to lung malignancy and studied with this in mind.

In this paper all cases of primary carcinoma of the lung from 1900 through 1947 at St. Luke's Hospital, New York City, are reviewed in two groupings. The first group from 1900 though 1935 was made by Frissell and Knox[1] and the second group from 1936 through 1947 is presented by the author through the Department of Otolaryngology. All cases were carefully reviewed and only those of proven pathology were included. Later in this paper statistics covering earliest symptoms, duration of symptoms, incidence by age, years and by hospital admissions will be presented.

Carcinoma of a specialized organ, in this case the lung, brings about an interesting and complex symptomatology through altered physiology and secondary changes. An obstructive adenoma may cause the same initial picture as seen in pneumonia where the mucous plug causes atelectasis by reason of blocking off the stem bronchus.

Coryllos[2] showed by dog experiments that plugs implanted by the use of the bronchoscope would bring about sealing of that lung segment with atelectatic changes and this could be overcome by the removal of the plug before secondary changes, pathological, took place. I had the pleasure of seeing some of this work being done while doing experimental surgery on dogs at the Loomis Laboratory of Cornell University Medical College.

The mechanics of respiration is not only interesting but quite important in the understanding of various phases of the pathological changes and the causes behind these processes. During a 24-hour period the respired amount of air which passes through the lungs totals about 15,000 liters. During the respiratory cycle the maximum change in pressure is from −70 to +100 mm. of mercury. An adenoma can cause alteration in the amount of air passing through that segment of lung, resulting in either atelectasis or emphysema whether it acts as a simple obstruction or ball-valve respectively. During coughing the intrapulmonic pressure becomes greater and will produce the emphysema should the expiratory phase, alone, be restricted. The adenoma, acting as a complete obstruction, will bring about atelectasis by absorption of air in the closed space.

The lung is invested with elastic fibers which deflate, to varying degrees, the lung at the close of the positive pressure period. The positive pressure period is initiated by the inhibition of the diaphragm and intercostal muscles. Conversely, the contraction of these muscles will initiate the negative pressure period.

Pearce[3] states, "The relative part which the diaphragm and intercostal muscles play in the widening of the thorax is of some importance from the standpoint of diagnosis." In interpreting chest x-ray films the contours of the diaphragm and the intercostal spaces are important findings to support observations seen in the rest of the lung fields.

It is not intended to go into the various pathological classifications of cancer of the lung, but rather to correlate the symptoms with the location of the early growth. Rienhoff[4] localizes them as hilar and peripheral. The hilar type is divided into the intrabronchial and extrabronchial, each producing different symptoms. In the hilar type the intrabronchial lesion produces respiratory symptoms and changes, while the extrabronchial lesion produces pressure symptoms and changes in the mediastinal structures as stasis of the vena cava, laryngeal nerve palsy, Horner's syndrome and brachial plexus pains. Superior sulcus lesions also will produce this type of symptomatology depending on the size of the lesion. The peripheral type may produce tenderness to palpation and percussion, and if the rib is involved it may be identified by the local symptoms. It may or may not have x-ray evidence. Invasion of the ribs is not uncommon. Frissell and Knox[1] state that lung cancer has the tendency to invade the mediastinum and heart muscle. This fact is illustrated by a case of mechanical right heart failure reported by

Levy.[5] This patient had an upper respiratory infection that lasted two months with a cough and soreness in the left chest. Later this patient developed right axis deviation and a rough systolic murmur. Autopsy showed the presence of a large oat-cell cancer arising at the tracheal bifurcation extending through the pericardium and compressing the pulmonary artery. This case shows how bizarre the symptoms may be and later, in the discussion of the symptoms, more interesting cases without chest symptoms will be reported.

The early diagnosis of primary carcinoma of the lung is made by correlating the symptoms, physical findings, and the results obtained by special procedures. The symptoms depend on the location of the lesion, the degree of invasion, mechanical effects such as atelectasis and emphysema, and secondary infections such as pneumonitis and abscess formation. The early presenting symptoms are cough, hemoptysis, pain (dull feeling, pressure, ache or true pain), weight loss, pneumonitis, and fever.

The special procedures for diagnosis are x-ray, tomography, bronchoscopy, bronchography, aspiration biopsy, pleural fluid cell study (Mandelbaum test), bronchial secretion study (Papanicolaou method), thoracoscopy, exploratory thoracotomy, and the response to radiotherapy.

The discussion of the early symptoms will be in order as mentioned:

1. *Cough.* This is the main presenting symptom of the intrabronchial type of lesion by reason of the foreign body irritation on the mucosal nerve endings, especially on the nerve plexus situated on each of the subsequent bifurcations from the carina down the bronchial tree. The cough at first is irritative in character and dry, then later becomes productive with mucus, blood or pus depending on the pathological changes distal to the lesion. Churchill[6] states that nearly everyone coughs more or less and that the cough that hangs on should be investigated. He further adds that cough is present in over half the cases of primary carcinoma of the lung, and is present in 90% of the cases in the later stages of the disease. Overholt[7] mentions that the growth in three-fourths of all primary lesions is situated within a stem bronchus thereby causing disturbance before the growth attains any great size, and in his series of cases a dry irritative cough was present in 88% and that the cough which fails to respond to usual remedies should be investigated. Cough, wheezing, dyspnea are produced by varying degrees of distortion and com-

pression of the lumen of the trachea, and the bronchial tree, as pointed out by Kernan.[8] He also feels that these symptoms may be caused in children by calcified nodes and in adults by enlarged glands along the mediastinum, and should be ruled out. Prolonged expiratory phase with wheezing or persistent ronchi over one area of the chest, according to Pool[9] is always suggestive evidence of partial bronchial obstruction. If persistent on repeated examinations, growths rather than a mucous plug should be considered as the probable blocking agent.

2. *Hemoptysis.* Erosions of mucosa lining the bronchial tree or covering an adenoma will cause hemoptysis. It is important to rule out bleeding from varices of both the bronchial tree and esophagus as well as bleeding from the oropharynx and gastrointestinal tract. Hemoptysis from a cancer is present with the intrabronchial type of lesion and from the erosion of an extrabronchial type of lesion that has invaded the bronchial tree. The peripheral type will not cause hemoptysis except by the same method of erosion by invasion. Bleeding is in no way different from that seen in pulmonary tuberculosis according to Pool[9] and there is, in short, no characteristic history to differentiate primary lung cancer from other lung diseases. Churchill[6] adds that hemoptysis is a first symptom in 5% of cases and sooner or later is present in 40-50%. Moreover, it is not the quantity but rather the persistence of bleeding that is significant.

3. *Pain.* This heading is used as an inclusive term to cover dull feeling, pressure, tightness, ache, or true pain. Pain is dependent on the location of the lesion as well as the size of the lesion. True pain is evidence of the cancer expanding or invading the mediastinum or thoracic cage. Extension of the lesion about the brachial plexus will cause radiating arm pains. The pain symptom is subjective and we must evaluate the patient's response to interrogations as to the nature of the pain, and often they are at loss as how to answer save ache, discomfort, pressure, dull feeling or experiencing true pain.

4. *Weight Loss.* It is interesting to note in the accompanying symptom table that many of the patients reported weight loss with seemingly little progress in the lesion growth. Perhaps the patients become introspective, worry over their symptoms and eat less.

5. *Pneumonitis.* This occurs as a secondary infection either as a localized pneumonia or abscess formation distal to the occlusion of

the segmental bronchus. This secondary infection may overshadow the primary lesion in the x-ray picture.

6. *Fever.* This symptom is a result of local infection or from the absorption of karyolytic products of the carcinoma.

In this second grouping of cases of primary carcinoma of the lung from the St. Luke's series, 1936 through 1947, 90 cases were reviewed. Of this group 75 were men and 15 were women. This ratio of 6:1 agrees with other reported sex ratios.

Table 1. *Earliest Symptoms.* In cases where cough was the earliest symptom some of the patients reported that hemoptysis occurred at the same time. Quite a number of patients stated that weight loss was the earliest symptom. Could it be that during the early latent period of the lesion that weight loss occurs? It is interesting to note that such a large number of patients complained of weight loss as the earliest symptom. Possibly this is due to the increased awareness of the serious import of weight loss being a sign of tuberculosis. Since everybody coughs more or less, people are less concerned by that symptom than by weight loss. The earliest symptoms were as follows:

SYMPTOMS	CASES
Cough	38
Pain	17
Weight loss	22
Hemoptysis	18
Dyspnea	9

There were five cases admitted to the hospital with no chest symptoms. Of these, three were admitted because of symptoms due to metastasis from a silent primary lesion. The other two patients were accidentally discovered to have lung malignancies while in the hospital for irrelevant causes, namely, for a hand infection and for gastrointestinal disturbances. The patient with the hand infection, after being in the hospital for a week, suddenly developed hemoptysis and massive atelectasis.

Table 2. *Longest Symptom.* In this group two patients reported a cough for 30 years. It is interesting to speculate that the cough, by constant irritation, might have been a factor in the development of the malignant lesion.

DURATION BY MONTHS	CASES
0-1	16
1-3	22
3-6	13
6-12	15
12+	12

Table 3. *Average Duration.* In this group the two cases previously mentioned of coughing for 30 years were not included since it is unlikely that a malignant lesion was present for this long a period.

DURATION BY MONTHS	
Cough	9
Pain	6
Hemoptysis	6
Weight loss	4½
Dyspnea	2

Table 4. *Age Incidence.* The age incidence agrees, in general, with other reported series of lung malignancies. It is slightly higher in the eighth decade and this might be due to the increased period of life expectancy, which during the past 45 years has been increased slightly over 15 years.

YEARS	CASES
10-20	1 (16 years of age)
20-30	3
30-40	3
40-50	10
50-60	41
60-70	28
70-80	6

The early diagnosis of primary carcinoma of the lung, aside from the symptomatology, is aided by the following special procedures:

1. *X-ray.* In the early stages of the cancer it is very difficult to detect the lesion, especially near the hilum where there is usually some thickening from inspired dust and from glands that have had active inflammatory processes. Atelectasis develops with a sealing off of a segment either by obstruction or compression of the bronchus. Later, fluid may collect or abscess formation take place and

a fluid level may be seen. With either pneumonitis or abscess formation the picture will be more difficult to interpret. Later the hilar lymph nodes may be involved by the spread of the lesion, further increasing the density. With marked nodal and extrabronchial spread, distortion may be seen in the bronchial tree. Solitary peripheral lesions are more easily detected radiographically.

2. *Tomography.* When a lesion is detected or suspected, serial pictures taken of that region may help to localize the mass. This is of particular benefit when aspiration biopsy or surgical intervention is contemplated.

3. *Bronchoscopy.* Visualization of the bronchial tree is important in the very early stages of the cancer since bronchiogenic lesions in the form of adenomas may be amenable to complete removal, or a biopsy done of the mucosa of questionable appearance. Early detection of a lesion will save valuable time in therapy, be it irradiation or surgical intervention. Churchill[6] believes that bronchoscopy can be expected to yield a biopsy specimen that provides microscopic confirmation of the diagnosis in 60-70% of the cases.

Visualization of mucosal changes, striations, easy bleeding points, growths, granulations, and distortion of the bronchial tree are indicative of malignancy. If the symptoms strongly suggest malignancy, even though bronchoscopy be negative, it is then quite important to have repeated x-ray and tomographical study.

4. *Bronchogram.* Radiopaque contrast study of the bronchial tree in the suspected area should be reserved until other procedures have been exhausted, especially in the presence of an infection, and also because further x-ray study would be made more difficult by reason of the instilled contrast media.

5. *Aspiration Biopsy.* This is not without some hazard by reason of possible air embolus or abscess formation. In this matter of aspiration biopsy, Overholt[7] is not convinced that the method is practical in operative cases. One patient who came to his attention had developed empyema following attempts at thoracic aspiration, and the complication was a determining factor in the patient's inability to survive pneumonectomy. He further adds that a negative aspiration does not disprove cancer and therefore thoracic exploration may still be indicated.

6. *Cytological Methods.* Pleural fluid study as developed by Mandelbaum and the cell smear improved by Papanicolaou are help-

ful in making a diagnosis of cancer, but are not as reliable as biopsy. Papanicolaou[10] states, "The biopsy is, of course, superior to the smear in other respects. It provides information as to the pattern and type of the tumor, its proliferative activity and invasiveness." He adds that smears are simple to do, cause no inconvenience, make possible repeated examinations, and provide for possible diagnosis in the incipient stage of the growth. The employment of this cytological method calls for study of the smear by a skilled pathologist. It must be born in mind that cells may be present having characteristics of a tumor while section of a removed tumor shows benign tissue.

In a series of 30 consecutive cases of primary carcinoma, reported by Herbut and Clerf,[11] cancer cells were demonstrated in 22 of them, an average of 73%. In the same series endoscopic biopsy was positive in 11 of the cases, an average of 36%. Cancer cells were present in bronchial secretions of 7 patients where bronchoscopy revealed nothing abnormal. When bizarre single cells are found, there is no question of the process being cancerous.

7. *Thoracoscopy.* Visualization of the peripheral portion of the lung may aid in the diagnosis if tissue for biopsy is available or if the pleura shows the peripheral type of cancer arising from the terminal alveolar lining cells. Further visualization may be obtained by thoracotomy, if indicated.

8. *Response to Irradiation.* In certain cases where the diagnosis is probable, even though not completely proven, the diminution in the size of the lesion subsequent to x-ray treatment lends further weight to the possibility of the diagnosis being correct. This is especially profitable where operative intervention is impractical. The value of this approach is determined by follow-up with repeated chest x-ray films and tomography.

In the period 1900-1947, there were 321,093 hospital admissions of which 129 were proven cases of primary carcinoma of the lung. During these years there was a gradual increase in the number of total hospital admissions as well as in the number of cases of lung cancer.

The following graph shows the number of cases of primary carcinoma of the lung in the St. Luke's series. The broken line indicates those cases covered in the first grouping by Frissell and Knox[1] and the solid line indicates those cases in the second group from 1936

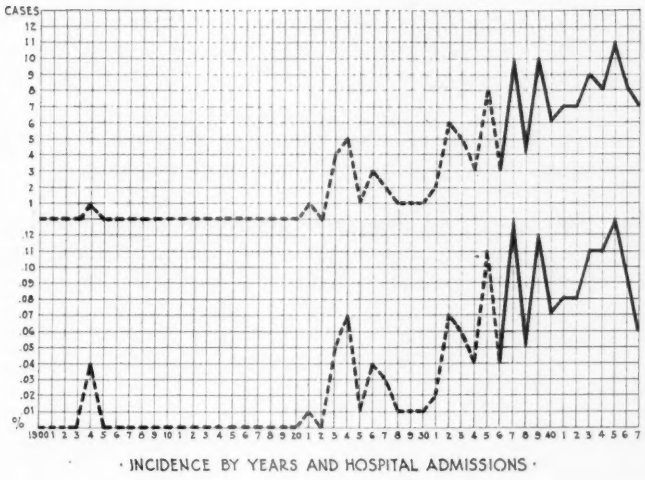

Fig. 1.

through 1947. The double graph shows both the number of proven cases and the percentage of cases by hospital admissions for those years. There is an increase in the number of cases of lung cancer beginning in the early twenties. The rise is a progressive one, especially from 1930 to the present. Both of these graphs are parallel.

SUMMARY

The St. Luke's series of primary carcinoma of the lung is interesting when comparing the yearly incidence against the percentage by hospital admissions. Both of these values on the graph are parallel but do not show the true picture of the real increase of lung cancer. In recent years there has been an increase in the number of hospital admissions for less serious illnesses due to participation in hospital plans. One might expect this to lead to decrease in the percentage rate of admissions for carcinoma of the lung. However, the rate has increased.

CONCLUSIONS

1. There is an increase in the number of reported cases of primary carcinoma of the lung.

2. This increase might be due to the increased awareness of the public to malignancies, the increased life expectancy by reason of controlled infections and contagious diseases, and by the use of chemo- and biotherapy.

3. The unexplained cough should be thoroughly investigated and suspected as being primary carcinoma of the lung.

4. Full use of all diagnostic procedures should be made to establish a diagnosis, and these repeated until the possibility of a malignancy has been confirmed or ruled out.

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XXXIV

TRANSITIONAL CELL CARCINOMA OF THE PARANASAL SINUSES

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Problems of diagnosis and management of anaplastic carcinoma involving the sinuses are infrequently encountered. The primary site may occur in the sinuses, lateral wall of the nose, or in Waldeyer's Ring, and in advanced cases may be only a matter of conjecture. Initial response of the tumor to surgery, irradiation, or a combination of both may be most gratifying. Subsequent extension or recurrence, however, often merely confirm the original diagnosis; and though life has been prolonged, the prognosis is unchanged and the outcome only temporarily deferred.

Five cases from the Massachusetts Eye and Ear Infirmary are reported. Four patients were hospitalized within a three-month period for diagnosis and initiation or continuation of treatment.

Case 1.—A 20-year-old white female was first seen on July 19, 1940, by one of us (L.A.S.) with a chief complaint of watering of her right eye for eight weeks. Treatment of the eye had not afforded relief, and glands in the right side of the neck became swollen and tender. Bed rest for ten days at home was followed only by further enlargement of the glands in the neck. Onset of double vision occurred one week prior to examination. Symptoms of head colds, sore throat or fever associated with the present illness were denied.

On examination, there was 4 mm. of exophthalmos of the right eye, and the globe was displaced outward and downward. A smooth tumor mass, arising from the anterior tip of the right middle turbinate, blocked the upper portion of the right nasal fossa. The postnasal space was normal and tonsils were absent. Right cervical

adenopathy was marked, the upper chain being about 3 cm. in diameter and the submaxillary gland moderately enlarged. X-ray examination of the sinuses revealed destruction of the inner wall of the right orbit with a question of pansinusitis. Biopsy of the right turbinate, and also of the cervical gland showed epidermoid carcinoma, Grade IV, and question of lympho-epithelioma or transitional cell carcinoma.

Six weeks later, after completion of 4200 r units of x-radiation to both the right lateral wall of the nose and to the right side of the neck, the metastatic mass in the neck had entirely regressed, and the exophthalmos was distinctly improved, although there was still slight fullness of the inner canthus on the right. The intranasal condition, however, appeared to have progressed. It now extended into the right ethmoid region above the middle turbinate. This concha was tremendously swollen and displaced toward the septum.

Two weeks later, the tumor in the nose showed marked regression, the middle turbinate having decreased considerably in size. One month following this, the patient showed definite improvement. The exophthalmos of the right eye had completely disappeared. Fullness in the right middle meatus, however, persisted. The mucous membrane was smooth with no evidence of ulceration or bleeding point. One month subsequently, the patient was breathing well through the nose and examination showed marked diminution in the size of the right middle turbinate. Two months later there was apparently complete regression of the tumor mass which had previously occupied the right ethmoid region.

The patient was followed for a period of five years. Five and one half years after completion of therapy there was no evidence of recurrence and x-ray examination of the sinuses was reported as showing the sinuses clear with no evidence of infection or tumor.

CASE 2.—A 47-year-old Italian male was first seen in May, 1945, with a chief complaint of right-sided headache and right nasal obstruction with occasional streaking of nasal secretion with blood for a period of two months. On examination, a polypoid mass which bled easily on touch was found in the right middle meatus. X-ray films of the sinuses showed the right frontal sinus completely filled with pus under pressure and evidence of a break-through of the bony interfrontal septum. A polypectomy was performed in the Out-Patient Department. Because of continued blockage of the right

nasal passage and failure to respond to conservative therapy, a biopsy of the granulating tabs in the right middle meatus was performed. This was reported as acute inflammation with necrosis and hemorrhage.

In view of continuation of the chief complaint the patient was admitted to the hospital on July 3, 1945, and since there was no change in x-ray findings, a right radical frontal and extranasal ethmoidectomy with insertion of tantalum foil was performed under general anesthesia. At operation, a defect was found in the inner third of the floor of the right frontal sinus, through which pus under pressure was evacuated. There was also a large defect in the lacrimal bone, and the ethmoid cells were filled with pus and polypoid membrane. The floor of the right frontal sinus was removed in its entirety and a piece of tantalum foil was sutured to the orbital periosteum and laid down into the vault of the nasal cavity. Routine postoperative follow-up was not completed by the patient.

Re-admission occurred in January, 1946, with a chief complaint of diplopia and blurring of vision, which had been slowly progressive during the previous six months. X-ray films of the skull showed no evidence of metastatic carcinoma. Biopsy of the right frontal and ethmoid was performed. The frontal sinus appeared filled with granular fibrous tissue and the biopsy report showed chronic inflammation and fibrosis.

The second re-admission occurred in April, 1946, for a biopsy of a mass in the region of the inner canthus of the right eye which, on gross appearance, resembled a mucocele. The biopsy was reported as carcinoma, rapidly growing, with insufficient tissue to grade. No further surgery was advised and x-ray therapy was instituted.

By June of 1946, the patient had received 6200 r to the region of the right anterior ethmoid and orbit, with the understanding that because of the large amount of irradiation felt necessary he might lose his right eye. One month later follow-up showed that the growth evidently responded very satisfactorily. There was no outcropping visible in the nose anteriorly nor in the region of the choanae. There was no exophthalmos nor limitation of movement of the right globe.

In July, 1947, after being followed at intervals in the Tumor Clinic, it was felt that there was definite activity on the right side of the nasopharynx and in the posterior ethmoid region. Additional

x-radiation in the amount of 4500 r was delivered on the 1500 Kilovolt machine and this was tolerated well.

In October, 1947, on routine follow-up, the sudden appearance of a large, easily bleeding mass bathed in pus and filling the right nasal fossa with symptoms and signs of an orbital abscess occasioned re-admission. Prompt but incomplete subsidence on chemotherapy was followed by a right lateral rhinotomy and exenteration of the right orbit for drainage and possible control of extension. A report of transitional cell carcinoma was obtained.

In January, 1948, because of pain in the right ear and over the right mastoid of one week's duration, associated during the previous two days with mild fever, the patient was seen in the Ear, Nose and Throat Clinic. There was periosteal thickening over the right mastoid, with sagging of the right posterior superior canal wall and marked tenderness over the entire mastoid process. X-ray examination of the mastoids showed increased density of the right mastoid. Skull films revealed marked destruction of the apex of the right orbit. The impression at that time was extension of carcinoma to the orbit and right mastoid. Because there was subsequent decrease in the postaural swelling and the hearing test showed evidence of high tone loss only, it was felt that the reaction was probably due to irradiation rather than to infection.

Two weeks later, the patient was again seen because of severe pain behind the right eye and in and about the right ear and mastoid, with no relief from codeine. He was re-admitted to the hospital, as an emergency, with a tentative diagnosis of intracranial extension of transitional cell carcinoma with involvement of the entire apex of the orbit. X-ray examination on admission showed destruction of the tip of the right mastoid, with the petrous negative.

The infection of the right mastoid was felt to be due to a retrograde extension of the mucopurulent discharge from the exenterated orbit and antrum and ethmoid, with pus flowing down over the right eustachian orifice almost continuously in small amounts. A right simple mastoidectomy was done. The mastoid cortex was roughened and soft with a small break-through in the cortical wall. All cells were necrotic and broken down, with foul pus throughout. The entire lateral sinus plate had been destroyed by disease, only a few thin pieces of bone remaining in this area. Foul pus and granulations were found in the antrum and middle ear.

Following operation, the postaural wound failed to heal and the middle ear continued to drain a small amount of thin seropurulent material. Culture showed beta hemolytic streptococcus, group A virulent. It was felt that failure of the mastoid wound to close was probably the result of devitalization of the bone following heavy doses of x-radiation, plus continued nasal and sphenoid suppuration.

In February, 1948, a small, grayish, slightly roughened area in the supra-orbital rim on the right side was noted. This continued to enlarge slowly. Biopsy showed recurrent transitional cell carcinoma. An additional 2000 r of x-radiation were given to this area.

The postoperative and postradiation course was complicated in March by sudden onset of severe right-sided headache, soreness of the right side of the neck and fever of 105.4° F. by rectum. It was felt that the possible complications at this time were: extension of tumor with infection from the site of biopsy from the supra-orbital area to the meninges; meningitis by way of the apex of the orbit with tumor extension plus infection; possible cavernous sinus thrombosis in view of the fact that the patient had definite suppuration of the right sphenoid; lateral sinus thrombosis or an epidural or extradural abscess by way of the tegmen of the right middle ear which was continually draining. Lumbar tap showed normal dynamics, clear, colorless fluid and only five lymphocytes on cell count. Heavy doses of penicillin and sulfadiazine were started and within 24 hours symptoms had subsided.

Subsequently, four separate sites of recurrence were visible in the orbital-antro-nasal cavity as shown in Fig. 1.

Progressive dimness of vision of the remaining left eye began in June, 1948. X-ray studies showed destruction of the anterior clinoid processes of the sphenoid bone. Discharge persisted from the right postaural fistula. Frontal and occipital headaches were prominent and intermittently, but increasingly, severe. Death occurred at home on September 21, 1948, while awaiting transfer to a hospital for terminal care. Date of hospital notification precluded the possibility of postmortem examination.

CASE 3.—A 42-year-old white female was first seen on September 23, 1946, having noted pain of increasing severity in the upper left jaw and teeth over a period of approximately three months. One month prior to examination, the patient consulted her dentist. A

Fig. 1. Case 2.—Age 47 years.

questionable cavity beneath a gold filling in the left upper second premolar tooth was found and extraction performed. The pain persisted, became continuous, and four days later was associated with swelling of the left cheek. Penicillin was prescribed and incision and drainage through the alveolar margin was performed on three occasions without recovery of pus. Four days prior to admission, the patient received one x-ray treatment which was followed by increase of the pain and redness and marked swelling of the left cheek.

On initial examination, the face was asymmetrical due to a 5-cm. swelling of the left cheek (see Fig. 2). No paralysis was noted. The lateral wall of the nose bulged slightly into the left nasal fossa but there was no gross outcropping or pus present. The left antrum was dark on transillumination and the remainder of the sinuses were clear. Fair dental hygiene was present and at the site of the recent extraction, a hemorrhagic fungating mass protruded through the alveolar margin and involved its edges (see Fig. 3). The nasopharynx was entirely normal and there was no cervical adenopathy. The patient was admitted to the hospital with a diagnosis of moderately far advanced carcinoma involving the left maxillary sinus with local extension through the anterior wall of the left antrum and the left upper alveolar margin.

X-ray films of the sinuses showed the left antrum full, the bone eroded, the soft tissue thickened and a question of carcinoma of the

Fig. 2. Case 3.—Age 42 years. Appearance on hospital admission.

left antrum. Biopsy of the alveolar mass was reported as epidermoid carcinoma, Grade II. Four days following admission, a peroral resection of the left superior maxilla was performed. Pathological report of tissue submitted from the operation was transitional cell carcinoma involving the left antral wall and floor. The patient had an uncomplicated immediate postoperative course. X-ray therapy was started on the tenth postoperative day and a total of 5000 r units was delivered to the region of the left antrum, treatment being completed on November 5, 1946. A total of 1200 r to each side of the neck was administered between November 12 and November 21, 1946. Following completion of therapy, there was sequestration of a portion of the left upper jaw and a transient infection of the left submaxillary gland. This appeared to be the lymph gland rather than the salivary gland. Fitting of a dental prosthesis was delayed because of the sequestration.

On March 27, 1947, a large sequestrum remained and could not be removed easily. With this exception, the cavity appeared wide open and well healed without signs of a local recurrence. Small sequestra appeared throughout the spring and summer of 1947. A biopsy of a suspicious area on the palatal margin was performed on August 14, 1947, and reported as recurrent transitional cell carcinoma. Additional x-radiation was given, a total of 3900 r being completed on October 3, 1947. One month later, left facial pain required codeine for relief and trismus had developed. By December 4, 1947, codeine would no longer provide relief. There was consider-

Fig. 3. Case 3.—Age 42 years. Appearance on hospital admission.

able bone necrosis in the region of the irradiated field and she was re-admitted to the hospital.

Marked contraction and induration of the left cheek were present with a 1.5-cm. area in the center of the cheek which was black, necrotic and dry with two perforations directly into the left antrum and mouth. Marked trismus, stiffness of the left side of the neck and an exudate lining the oro-antral cavity were evident.

The possibility of a prefrontal lobotomy for control of intractable pain was considered, but in view of favorable response to penicillin and tube feeding mixtures necessitated by the trismus, the pain lessened markedly and the neurosurgical consultant favored postponement of any such procedure. Recurrence of pain would suggest a gasserian neurectomy rather than a prefrontal lobotomy.

Additional aid in the nutrition problem might have been obtained from lower incisor extractions but because of the large dosage of irradiation with the mandible in the field undoubtedly osteomyelitis would have developed to further complicate the case.

Self care of the oro-antral-cutaneous fistula after each feeding was instituted and the nasal feeding tube was removed on January 7, 1948.

Fig. 4. Case 3.—Age 43 years. Appearance on hospital discharge, January, 1948.

An isotonic aqueous solution of papain was tried as an aid to oral hygiene. Within 24 hours, local redness of the skin about the fistula and a right conjunctivitis occurred. Discontinuance of papain and pyribenzamine therapy was followed by prompt subsidence. The conjunctivitis was similar in mode of onset to that which occurred following use of a mouth wash of similar taste six months previously. A papain sensitivity was suggested. However, subsequent developments pointed to an osteomyelitis of the superior maxilla as the correct explanation. On January 17, 1948, slight edema of the left lower lid was noticed. X-ray examination was repeated and showed osteomyelitis of the superior maxilla and malar bone on the left with sequestrum formation. Response to sulfadiazine, in addition to the penicillin already being received, was evident within 48 hours and signs and symptoms had entirely disappeared within six days.

Hospital discharge occurred on January 26, 1948, it being felt that no further treatment could be offered, and that any attempt to remove the sequestrum in the posterior wall of the left antrum (see Fig. 4) might merely hasten the patient's demise.

Recurrent episodes of pain and swelling over the left zygoma and of the eyelids bilaterally with subsequent abscess formation superficially in the left temporal region subsided following incision and drainage.

Severe left-sided pain finally responded to section of the fifth and ninth nerves and the patient is now dressing her large left facial

cavity at home and masking it with a specially constructed prosthesis.

CASE 4.—A 29-year-old white female was admitted on February 12, 1948, with a chief complaint of pain and swelling of the throat intermittently for five and one-half months. Progress had been markedly worse during the past month.

The onset was characterized only by slight discomfort in the left side of the throat. On looking in the mirror the patient noted a few pearly white blebs in the region of the left tonsil. The discomfort subsided spontaneously after approximately one week. Approximately four and one-half months prior to admission delivery of her third child occurred spontaneously at full term. One month following confinement there was recurrence of discomfort in the left side of the throat. Since that time steady progress of swelling and pain in this area was noted. One month prior to admission difficulty in eating first occurred, and she was referred by her local physician to an otolaryngologist. Weight loss of 35 lb. was recorded and biopsy of the left tonsil on several occasions was reported as chronic inflammation. Cultures from the ulcerated left tonsil showed staphylococcus, an unidentified yeast culture but no Vincent's organisms. Chest plates were negative for tuberculosis. X-ray films of the skull and facial bones were reported negative. Blood studies were reported negative for evidence of leukemia. Sulfadiazine, penicillin and streptomycin therapy and gentian violet applied topically to the ulcer of the left tonsil did not alter the situation.

Positive findings on initial examination included purulent discharge on the floor of both nasal fossae, a large area of ulceration which was covered with a dirty grayish-yellow membrane and included both tonsillar fossae, all of the soft palate, and the posterior half of the hard palate. The area of destruction and outcropping also included the posterior aspect of the tongue on the left side. Trismus permitted 1-cm. opening of the jaws. On the left side of the face and neck very hard nontender swelling extended from the canine fossa upward to the zygoma posteriorly to the mastoid tip, and extended inferiorly to the upper border of the thyroid cartilage from the anterior border of the sternomastoid to the midline. A complete left facial paralysis was present on the left. No palpable cervical adenopathy was present.

Nasal culture showed abundant Staphylococcus albus with a few beta hemolytic streptococci. X-ray films of the chest were negative. Lateral film of the neck showed marked retropharyngeal swelling. X-ray examination of the sinuses showed a question of a

Fig. 5. Case 4.—Age 29 years. Full resolution of peripheral facial paralysis after 4100 r of x-radiation. Photograph taken on hospital discharge, March, 1948.

retropharyngeal abscess and in the left antrum a cyst or cystic membrane. Base of the skull showed destruction of the petrous apex, greater wing of the sphenoid, body of the sphenoid and hard palate with the left antrum full.

Biopsies of the cheek externally and of the base of the tongue were reported as highly anaplastic malignancy, question of lymphoepithelioma. X-radiation therapy was started at once and an estimated tumor dose of 4100 r was delivered, and completed on March 6, 1948. Marked clearing of the swelling of the left cheek, resolution of the facial paralysis, complete regression of trismus, and marked regression of the tumor followed rapidly (see Fig. 5 and 6).

Case 5.—A well preserved 81-year-old white male was first seen and entered the hospital on February 4, 1948, with a chief complaint of rapidly progressing swelling of the right cheek for one month. The onset was associated with epiphora of the right eye, and right-sided nasal obstruction for three weeks prior to admission to the hospital. He had noticed a rapidly increasing swelling of the right cheek, which spread over to the right side of the nose, and up to the inner canthus of the right eye. There had been no associated pain in the face, no cephalgia at any time, and no visual changes in either eye. Positive physical findings were: a small amount of yellow purulent discharge in the right eye; the right nasal fossa was completely blocked anteriorly by a grayish friable mass. The septum was pushed far to the left, blocking the left nasal fossa, only

Fig. 6. Case 4.—Age 29 years. Appearance on hospital discharge, March, 1948.

the anterior third of the septum being visible. There was a thin, yellow nasal discharge in the right nasal fossa. A hard, indurated swelling extending up to the lacrimal region, and the lower lid, closing the right eye was noted. The skin over this area was reddened. There was bulging of the hard palate on the right side, and the patient's full upper denture did not fit. A 1 x 2 cm. node in the upper right posterior cervical chain was noted; this was nontender.

X-ray films of the sinuses showed tumor involving the right ethmoid, with destruction of the naso-antral wall. A biopsy was obtained, and was followed by moderate bleeding which required a vaselin pack in the right nasal fossa to control hemorrhage. With the absence of pain, surgical drainage was not felt to be indicated, and the patient was referred for deep x-ray therapy.

Forty-five hundred r units measured in air was delivered to the right ethmoid, antrum, including orbit, and frontal region. Brisk erythema of the skin including conjunctiva was noted.

One month after completion of therapy, no evidence of tumor tissue was seen in the nasal cavity or nasopharynx. There were no palpable glands. There was remarkably little skin reaction present, with only moderate conjunctivitis and no subjective evidence of defective vision.

COMMENTS

With the exception of Case 4, the initial tumor site appeared to be in the paranasal sinuses.

Diagnosis.—The initial symptoms may give no suggestion as to the cause or site of primary pathology, particularly those related to apparent ocular or dental complaints. The importance of adequate early biopsy is again demonstrated.

Treatment.—X-radiation supplemented when necessary by surgery for drainage in the presence of acute superimposed infection plus large doses of antibiotic and chemo- therapy were used in the treatment of the cases reported.

Problems of management after recurrence of the original tumor or following palliative x-radiation included control of pain, maintenance of adequate diet in the presence of trismus, osteomyelitis of the superior maxilla and temporal bone, and the maintenance of hope in the patients with grave prognoses.

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XXXV

HEARING EVALUATION BY LOW CONVERSATIONAL VOICE TESTS

ARAM GLORIG, M.D.

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Years ago when ophthalmology was associated with otolaryngology it was convenient for a hearing test to be done in the same manner as an eye test. Hence the denominator of 20. I am sure it was probably for no better reason. Why in our day, when medical knowledge has advanced beyond any previous level, should we still use tests for hearing which are as far behind as bow and arrow warfare would be, particularly when we have good usable tests at hand?

Many others have discredited the low conversational voice hearing test. Hoople,[1] E. P. Fowler, Sr.,[2] and Jr.,[3] Work,[4] Knudsen and Jones,[5] and Canfield[6] have talked and written of its fallacies for years.

The need for change was foreseen by men such as those I have named long before World War II. Suggestions and recommendations were made in an attempt to rectify mistakes made in World War I, but in the hurry of raising a very large armed force the voices of those who warned of trouble were not heeded; consequently, all hearing tests were done in the old manner, not only when the men were inducted but also upon discharge. The Veterans Administration, too, stayed in the old rut when adjudicating disability caused by loss of hearing.

In the meantime defective hearing became a problem as a result of the noises and rigors of modern warfare and the need for rehabilitation of the deaf assumed large proportions. Centers were set up for care of the deafened and in their studies it became very apparent that tests used for induction were worthless when attempting to compare current hearing losses with past losses. Establishing service connection was next to impossible and certainly far from accurate.

From the Audiology and Speech Correction Center, Walter Reed General Hospital.

Injustices were done to both service personnel, veterans and to taxpayers. It was felt that something should be done to change the regulations in regard to service inductions before large numbers of men re-entered service under the new National Service programs and that something should be done concerning the proper adjustments of veterans with hearing losses. In an attempt to gather data concerning this problem the following experiments were done in the auditory rehabilitation unit at Walter Reed General Hospital.

The "speech tunnel," as the room designed for this test is called, measures approximately 5 ft. wide, 9 ft. high and 22 ft. long. The ceiling and walls down to the floor are lined with Softone with a co-efficient of 70 with carpet on the floor. This is far better than anything to be found in the average induction or separation units. When the experiments were begun even this room was found to have a large amount of standing wave effect. To eliminate this, woolen blankets were hung to cover the entire wall space. This helped considerably. The data presented here were gathered after the blankets were hung.

The room was equipped with a monitoring system. This includes a microphone, an amplifying unit and an output meter.

Each hearing test from then on was done in the following manner: The usual low conversational tests on each ear were given first. The procedure was then repeated with the microphone held close to the mouth, thereby monitoring the voice to reach a constant level during the test. This presumably would eliminate variations in the tester's voice, but still the patient was tested with the speaker's natural voice.

Up to the time of this report, 173 tests were done. All tests were done by Mr. Wickman, who has done the test several thousand times. Forty-two men were given repeat tests varying from two to six. The remainder had only one test.

In studying the entire 173 tests the following was found:

1. The unmonitored and monitored tests were fairly close if the readings were in the neighborhood of 20/20 or of 1/20. Otherwise the monitored tests varied 1-5 ft. lower than the unmonitored test. Since the monitoring assured a fairly constant output, it is safe to assume that some of the variation from the unmonitored test can be accounted for by variations in the voice of the tester.

2. In comparing these tests with pure tone audiometry and speech reception, the inconsistency was remarkable. The tests which were repeated several times on the same patient revealed the results shown below in Table I. The variation in results in the same patient was extreme. (All figures given may be considered to have a denominator of 20, proceeding from unmonitored right ear first.)

TABLE I
VARIATION BETWEEN TESTS ON SAME PATIENT

Patient	Date	Unmonitored AD	Unmonitored AS	Monitored AD	Monitored AS
1.	28 Nov. 47	9	17	7	12
	1 Dec. 47	12	16	7	12
	4 Dec. 47	10	16	7	13
	5 Dec. 47	13	20	7	17
	12 Dec. 47	10	16	10	14
	17 Dec. 47	12	20	10	18
2.	6 Nov. 47	14	5	9	2
	7 Nov. 47	15	13	10	4
3.	14 Nov. 47	20	15	12	13
	4 Dec. 47	16	16		
	8 Dec. 47	18	18	15	14
	12 Dec. 47	18	20	16	18
4.		18	0	16	0
		17	0	15	0
				15	0
				13	0
				7	0
5.	1 June 48	17	17	14	12
		16	18	11	14
		18	19	10	13
		16	16	12	12
6.		5	16	5	16
		7	13	7	13
				7	13
				9	18
				8	10

TABLE II
VARIATIONS BETWEEN EARS—SAME PATIENT WITH THE SAME PURE TONE LOSS IN EACH EAR

Patient	Date	Unmonitored AD	Unmonitored AS	Monitored AD	Monitored AS
1.	17 Dec. 47	10	20	7	17
	5 Dec. 47	12	9	8	6

TABLE III
VARIATIONS BETWEEN PATIENTS WITH SAME PURE TONE AND SPEECH RECEPTION LOSS

Patient	Pure Tone Average 512-2048		Unmonitored		Monitored	
	AD	AS	AD	AS	AD	AS
1.	40	52	11	12	7	7
2.	37	38	7	8	4	4
3.	37	28	17	18	11	13
4.	37	38	1	2	1	1
5.	38	37	14	14	8	8
6.	23	22	6	6	2	2
7.	25	25	20	20	18	18

All the above figures are based on patients whose responses to pure tone and speech reception tests were very consistent. They were chosen to eliminate as much subjective variation as possible. The above has been an evaluation from a clinical standpoint.

Let us now consider this problem from an acoustic viewpoint.

The following equipment was used in the study carried out in the room described above. A Standard General Radio type sound level meter microphone was set up in the patient's position. It was apparent that since words were to be used as testing material, reading this meter would not be too exact. To eliminate this source of error a pickup-recorder system made up of a Telex 1550 hearing aid, an attenuator for regulating input to the recorder, and a General Electric recording micro-ammeter, fitted with an instrument rectifier, was set up. Any signal fed from the aid was then recorded on the chart as a line varying as the amplitude of the signal picked up. Maximum levels were used.

As long as this system is maintained the results will be directly proportional to the sound gathered by the pickup and hence a series of tests may be run off with a good degree of assurance that they are comparable.

In order to compare the two methods of pickup, a P.A.L. static noise generator was used and held at a constant level fed into an 8-inch loud-speaker. The speaker was moved from point to point held on a level with average ear height. Static noise was used to

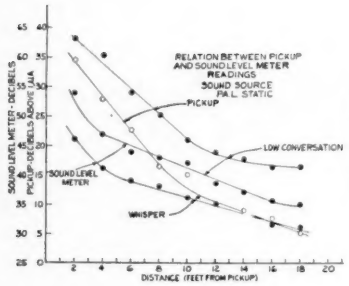
RELATION BETWEEN PICKUP AND SOUND LEVEL METER READINGS
SOUND SOURCE IN A.L. STATIC
PICKUP
LOW CONVERSATION
SOUND LEVEL METER
WHISPER
SOUND LEVEL METER - DECIBELS ABOVE 1 μA
PICKUP - DECIBELS ABOVE 1 μA
DISTANCE (FEET FROM PICKUP)

Fig. 1.

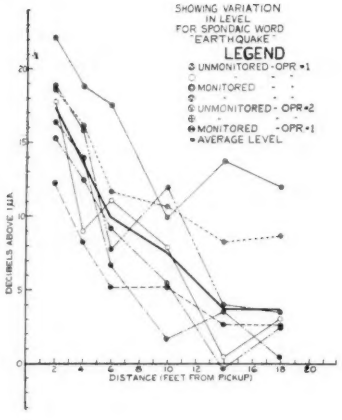

Fig. 2.

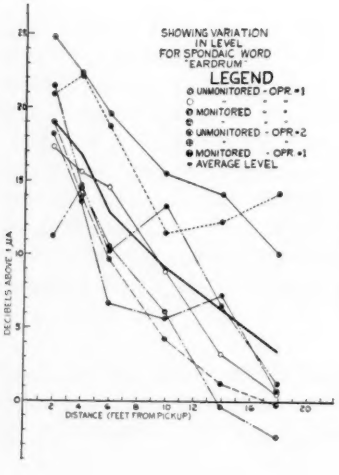

Fig. 3.

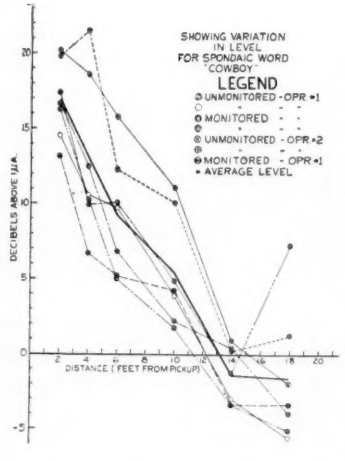

Fig. 4.

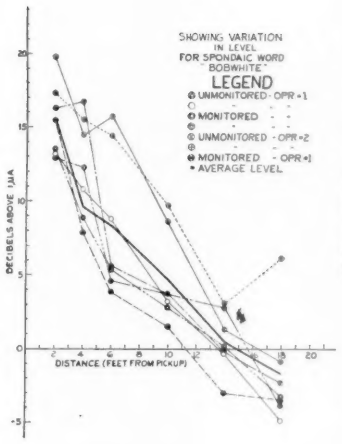

Fig. 5.

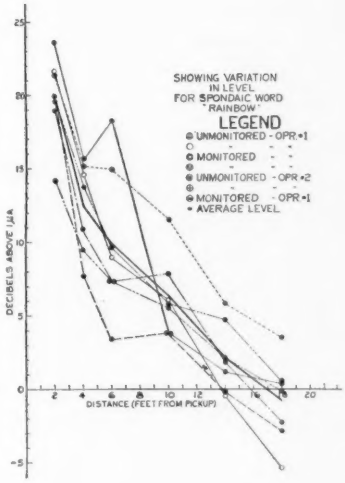

Fig. 6.

eliminate the standing wave effect encountered with pure tone. The results were recorded on the chart shown in Fig. 1. At the first glance there seem to be marked discrepancies in the two units, but these are not as serious as may be imagined.

The sound level meter scale is weighted to an entirely different type of measurement from the pickup used and while a pickup of the same characteristics is perhaps desirable, it is not necessary as long as there is a similarity between the two and the same pickup-recorder system is used throughout the tests.

It will be noticed that levels on the noise generator set to approximate the level of whispered and low conversational voice follow the same general pattern as the speaker is moved toward the pickup at intervals of 2 ft.

It is evident, too, that the significant increase in decibel value occurs as the distance decreased *below* 8 *ft.* There is an increase of 6 db down to 8 ft. with a total increase of 16 db at 2 ft. In other words, the increase during the last 6 ft. is greater than during the

first 12 ft. This will bear a close relation to the inverse square law which states: The intensity of sound varies inversely with the square of the distance.

This fact alone is enough to invalidate the standard testing method prescribed by the Army, Navy and Veterans Administration since it means an average increase of ½ db per ft. down to 8 ft. Is it any wonder 18/20 and 10/20 are practically interchangeable?

Let us proceed to the analysis of the word charts. Before analyzing the individual word charts, let it be emphasized that these tests are in no way intended to be a final report on this work. They constitute only a preliminary check but the results were so clear cut and so obviously pointed up the deficiencies of the accepted sound tests they are presented herewith.

All of these charts are made under as nearly actual working conditions as possible. Each chart represents the data collected on one of the five spondaic words used. S and *CH* sounds were purposely omitted in order to give a better check on the response without too wide a range in output level from syllable to syllable, since only the peaks were used and also because the recorder had but a 3 micro-ampere range and some words would have a range higher than this.

On inspection the charts very definitely show the variations which come from the use of the "low conversation voice test" (Fig. 2-6).

These variations are from word to word, time to time, distance to distance, tester to tester, and any one or combination of all may occur at any distance and with any word and the same tester. For that matter with any tester, even our Mr. Wickman who has done many thousands of these tests.

These charts show that with seven repetitions of the same word one may expect a dispersion of some 8-10 db at any distance from the pickup, a deviation of about 4-5 db from the average, and all this with a seasoned tester.

Just as an example of what might happen between testers, on the charts shown in Fig. 2, 3 and 5 there are starting variations of

9, 14 and 11 db, respectively, at the same distance with the same word. Tester No. 2 is, by the way, not altogether an amateur either.

It has been stated and pretty well proven by Fowler, Jr.,[7] that in doing spoken voice tests the tester automatically lowers and raises his voice as he approaches or leaves the patient. In these tests with only a pickup instrument to "speak to" this was not consistently true. However, to verify Fowler's statement a patient was placed next to the pickup and even though the tester was aware of the reason his voice showed a relative decrease on each test as he approached the patient. At the risk of repeating myself, what would happen with testers varying from poor to good? You will notice that in all this discussion nothing has been said about the room in which the test is done, nor the ambient noise which varies from 25 to 70 db depending upon the location. Add these even more important variables to the rest and the answer is the same, complete unreliability from test to test.

After this tirade against the spoken voice test you are no doubt asking, "What can we substitute for this method? What will adapt itself to the needs of mass mobilization and demobilization?" It has been shown by Harris,[8] Kinney,[9] Hunt,[10] and others that reasonable test-retest reliability in hearing tests can be obtained with both phonograph and pure tone group and sweep tests, and that furthermore these tests can be done more quickly than the voice tests as prescribed by present regulations. The electronic tools of the present are the obvious answer.

CONCLUSIONS

1. The "spoken voice" test has inherent faults which make it impossible to arrive at even approximate hearing thresholds.

2. The clinical variations shown are due in the most part to these faults.

3. According to all laws of acoustics the test is in no way practical or even admissible.

4. When we add to all this a multitude of different rooms and varied ambient noise levels it is no wonder the results are inconsistent.

I hope this paper adds at least a little weight to the evidence presented in the past and that eventually it will add up to enough to abolish this worse than useless method of testing hearing.

I would like to take this opportunity to thank Mr. Stiles, our engineer, and Mr. Wickman from our Acoustic Section for their assistance. It would have been impossible to gather the data in this discussion without their help.

WALTER REED GENERAL HOSPITAL.

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XXXVI

TUBERCULOSIS OF THE NOSE TREATED WITH STREPTOMYCIN

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BOSTON, MASS.

Tuberculosis of the nose is an unusual condition. It occurs secondary to pulmonary tuberculosis except in very rare instances. The condition shows a predilection for females and appears to be most prone to occur between the ages of 25 and 60.

The cartilaginous portion of the nasal septum is usually the initial site of involvement from where the lesion may spread to the lateral wall of the nose and, more rarely, to the nasal floor. Grossly, the lesions present themselves as an ulcer or a granulomatous tumor mass. Microscopically, the picture is quite characteristic of tuberculosis found elsewhere (Fig. 1). Discrete and confluent tubercles composed of a distinct zone of reticulo-endothelial cells surrounding a zone of caseation necrosis are found. Lymphocytes and, occasionally, fibroblasts are found peripheral to the reticulo-endothelial cells. Typical foreign body giant cells with their eccentrically arranged nuclei may be found scattered between the tubercles.

Various forms of treatment have been advocated for this condition, including local cleansing of the nose with alkaline antiseptic irrigations, applications of chaulmoogra oil, coagulation with various mild acids or with electrocoagulation, surgical excision of the lesions, and radium and x-ray therapy. In spite of all forms of treatment, there has been in many cases a strong tendency for the tubercular lesion to persist, and if it disappears, to return.

Streptomycin is a drug that offers much promise in the treatment of pulmonary tuberculosis. An opportunity was presented at the Massachusetts Eye and Ear Infirmary to determine the effectiveness of this drug in treatment of a case of tuberculosis of the nose.

From the Department of Otolaryngology, Massachusetts Eye and Ear Infirmary.

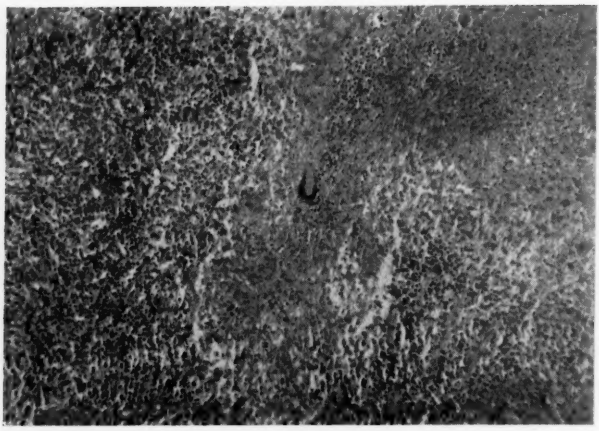

Fig. 1.—Photomicrograph of the section of tissue removed from the patient's nose in July, 1948. Section reported by Dr. Tracy Mallory as "tuberculous granuloma".

REPORT OF A CASE

The patient was a 65-year-old white male of Syrian extraction. The chief complaint was complete bilateral nasal obstruction which he had developed during a few weeks in January, 1947. Following this, he was treated by several physicians for this complaint with only temporary periods of relief. These treatments included bilateral intranasal antrotomy in February, 1947; a series of intranasal electrocoagulations in June, 1947; and a left external ethmoidectomy in February, 1948. In addition, he had been instructed to use several varieties of nose drops which apparently were chiefly vasoconstrictors. At one time, he was treated with sulfadiazine nose drops.

In July, 1948, some tissue was removed from the patient's nose. The pathological report on this tissue by Dr. Tracy Mallory was "tuberculous granuloma". Following this, the patient was placed on streptomycin nose drops composed of 0.1 gm. streptomycin per cc. of physiological saline, and he was admitted to the Eye and Ear Infirmary.

The patient gave a history of pulmonary tuberculosis as a child. Later, his doctors felt that he had completely recovered from this disease. Since 1933, he had had severe hypertensive cardiac disease for which he had been under constant medical care.

The general physical examination revealed a sickly, feeble-appearing white male. The blood pressure was 300/110; pulse rate 86; respiration, 20.

There were moist râles at the base of each lung and along the left cardiac border.

Examination of the heart revealed the apex impulse to be forceful and located in the fifth intercostal space 10.5 cm. from the midsternal line. There was a palpable but not audible gallop rhythm. The second aortic and second pulmonic sounds were of equal intensity. There was a Grade Two aortic systolic murmur. There were neither thrills nor transmission to the neck.

The abdomen was negative.

There was neither edema of the extremeties nor calf tenderness.

Examination of the nose revealed the anterior border of a fungating, raw-appearing mass presenting in the left nasal passage. It appeared to arise from the lateral wall in the region of the middle turbinate, extending medially to the septum and vertically to such an extent that the left nasal passage was entirely obstructed.

The right nasal passage was also almost completely obstructed. In the region of the middle turbinate, there was irregular tissue similar to the tissue seen on the left side. The right inferior turbinate was congested and there was crusting on its anterior tip.

The posterior choanae appeared normal by postnasal mirror examination.

The report of x-ray examination of the chest stated: "There is fibrosis and cavity formation of the right upper lobe. There is displacement of the trachea to the right. The left pleural cap is thickened with underlying infiltration. There is calcification on the left diaphragmatic pleura."

The electrocardiogram was suggestive of right ventricular strain on a hypertensive basis.

Streptomycin nose drops were continued throughout the patient's hospitalization, several drops being administered to each side of the nose four times daily. In addition, he received 1 gm. daily of streptomycin intramuscularly, given in two 0.5-gm. doses.

For his cardiac condition, he received digitalis, 0.1 gm. daily; strict low sodium diet; ammonium chloride, 1 gm. three times daily; Mercuhydrin, 1 cc. intramuscularly the day following admission.

The patient was hospitalized a total of 23 days. During this period he received a total of 23 gm. streptomycin by intramuscular injection and approximately 1 gm. intranasally in the form of nose drops. Simultaneously, there occurred a slow but progressive improvement in the patient's ability to inspire through his nose. The right side of the nose responded first; the left side, where the obstruction was so complete on admission, responded later and more slowly. Nine days after the initial intramuscular dose of streptomycin, he was able, for the first time in several months, to breathe through the left side of his nose. Both sides continued to improve during the balance of his hospitalization.

At the time of his discharge, examination of the nose revealed a slight but definite reduction in the amount of granulation tissue on both sides.

The patient has been seen four times at six-week intervals since his discharge. He has received no further streptomycin intramuscularly, but he has continued to use the streptomycin nose drops about four times daily.

There has been steady improvement in the breathing ability. On his last visit (24 weeks after discharge), he was breathing easily through the right side of his nose and with only slight difficulty through the left side. There had occurred a remarkable reduction in the amount of granulation tissue on both sides of the nose. The nasopharynx was clearly visible through the right nasal chamber. On the left side, there was approximately one-third the amount of granulation tissue that was present when streptomycin therapy was started and the mucosa had a much more healthy appearance.

SUMMARY

1. Tuberculosis of the nose is a condition which has proved refractive to previously described treatments in many instances.

2. A case of tuberculosis of the nose treated by streptomycin is reported.

3. Marked improvement has occurred with 27 weeks' therapy.

243 CHARLES STREET.

XXXVII

AN OPERATION FOR THE CORRECTION OF COLLAPSED NOSTRILS AND NARROWED EXTERNAL NARES

JOHN J. CONLEY, M.D

In the past ten years the external nose has received considerable attention from the plastic surgeons. Methods of attaining physical improvements about the nose have been outlined in some detail and many features of these operations are now standardized. However, the main effort has been directed at improving the line and contour of the dorsum and tip of the nose, and although the clinical entity of anterior subluxation of the septal cartilage has been discussed, the condition of collapsed nostrils and narrowed external nares has received scant attention. This is most likely due to the relative infrequency of the condition and the absence of any dramatic complaint on the part of the patient. Nevertheless, the condition possesses a unique position in both the local nasal and systemic physiology and general appearance of the nose. There are multiple interesting conditions causing a diminution in the size of the external nares, but the one we are chiefly concerned with here is that of the collapsed nostril. An operation for the correction of this defect is presented.

Anatomy. The detailed anatomy of the nasal tip varies considerably in different ages, sexes and racial groups. Children's nostrils are relatively smaller than adults. The male nostril is larger and more developed than the female. The Negro and Asiatic races usually present very patent and dilated nostrils. In the Semitic race the nostrils are somewhat hidden due to the length and convexity of the dorsum of the nose. The greatest tendency to collapse of the nostril with a resultant pinched-type of nose is found in the Anglo-saxon and Nordic races.

The external nares may be considered the primary inlet of the respiratory tract. The normal patency of the airway of this primary inlet is maintained by the natural convexity of the alar cartilages. These cartilages form a natural, elastic, resilient dome about the

dorsal part of the external nares. They are anchored in a rather loose fashion above to the upper lateral cartilages, medially in the columella and nasal septum and laterally to the cheek. Their contour is ordinarily fixed, but a certain amount of activity and movement is produced by two small muscles which dilate and two which constrict the opening. They also react in harmony with the movements of the lips, eyes and face. The anterior and posterior dilators in conjunction with the natural resiliency of the alar cartilages are responsible for maintaining the patency of the nares during ordinary respiration, but during difficult breathing and anger they contract forcibly causing an increase in the size of the nares. The depressor septi and nasalis muscles cause a diminution in the size of the nares by depressing and narrowing the air passage. This mobile patency is lined internally with stratified squamous epithelium containing hairs and externally with skin containing many sebaceous and sweat glands. Conjointly these structures, along with the nasal bones and ascending crest of the maxilla, lend shape, mass and position to the nasal pyramid.

Etiology. The etiology of collapsed or narrowed external nares is:

1. Congenital anatomical variations;
2. Post-traumatic;
3. Neuromuscular;
4. Postinfectious;
5. Associated with new growths.

In classifying the various types it is necessary to differentiate between the naris that is fully developed, yet collapsed, and narrowed so that only a chink remains for the air to pass through, and the very small stenotic opening where there is an actual diminution in the size of the potential air passage.

Types.

1. The collapsed or narrowed nostril of congenital origin usually presents maldevelopment in some portion of the alar cartilage or their associated soft parts. This may manifest itself as an intrinsic weakness or incomplete development of the cartilage itself. It may be apparent shortly after birth or it may appear during growth or after the nose is fully developed. The infant nostril is considerably more

oval in contour than the adult nostril. As the depth of the nose increases during growth, the length of the nostril increases proportionately, creating an oblong contour in the vertical plane. If there is maldevelopment or weakness of the alar cartilages during this growth period, the classical form of a narrow, pinched nostril may appear. Rarely does a flat or short nose, or one of little depth develop collapsed nostrils.

The narrowing may be unilateral or bilateral and involve the lateral crus, the dome, or the medial crus, or any combination of these. When it is unilateral and only of moderate degree there are rarely any symptoms and there is no tendency to progression because the air inlet is adequate for respiratory needs. However, if the collapse is bilateral and severe, normal and exaggerated inspiration is impossible because of the collapse and the patient complains of inability to breathe through the nose.

2. The traumatic factors causing collapse of the nostrils are not common. Any circumstance resulting from violence or injury that will cause sufficient narrowing or weakening of the structures constituting the external nares will permit alar collapse upon inspiration. Blunt force to the tip of the nose rarely affects the alar cartilages alone and is usually associated with dislocation of the nasal septum. Frequently the medial crus is displaced, further embarrassing the airway. When the nasal septum is subluxated to one side, that particular nostril may be narrowed in the presence of a normal cartilage. Lacerating injuries about the tip of the nose may cause scar contracture and collapse of the vestibule. Postoperative deformity associated with rhinoplastic procedures may produce sufficient scar and web or may injure the tip muscles and nerves sufficiently to cause collapse and immobilization of the alae. We have all seen the so-called "dead" or inactive nose following rhinoplastic surgery and many of these do have diminished vestibular airways, but fortunately only rarely do they manifest collapse.

3. The neuromuscular factors are associated with an intrinsic weakness in the dilators of the external nares. This may be the result of a paralysis of the facial nerves or undevelopment of the nasal muscles. If the nares are architecturally broad and the cartilaginous framework substantial, this phenomenon cannot develop. However, if the nares are anatomically narrow and the cartilage weak, collapse may appear as the result of decreased intranasal pres-

sure upon inspiration. Under these circumstances, the condition has a tendency to progress.

4. Postinfectious scarring and contracture is an uncommon cause of collapsed nostrils. Acute, recurrent, nonspecific infections about the vestibule never result in permanently narrowed nares. Chronic granulomatous infections associated with deep scarring may eventually cause collapse of the nostrils and diminished airway. Tuberculosis, chronic, mycotic infections and scleroderma of the nose belong in this group but fortunately are infrequently seen in this country. In these particular instances it is necessary to cure the local and general infection before any corrective surgery is contemplated.

5. Collapse of the nostrils associated with tumorous growths poses additional problems. The diminution in the size of the nares results from compression of the expanding tumor. In benign growths about the vestibule and alae, it is often necessary to resect a portion of the nose to cure the disease. Malignant growths associated with the alae or columella require the removal of large sections of tissue to control the disease. Both of these conditions require individualized plastic surgical techniques to restore normal contour to the nose.

Atresia and stenosis of the nostril as a consequence of arrested development of the nose may present the situation of collapse also. However, the fundamental problem here is different than in the so-called "pinched" or "narrowed" nose. The stenotic or atretic nostril has failed to develop or mature, whereas the collapsed or pinched nostril is completely developed anatomically but fails to supply a satisfactory air inlet because of an intrinsic weakness or variation in structural form. The former is corrected by complete release of the stenotic area by means of transposed skin flaps or a free graft. The latter is corrected by skeletonization and mobilization of the alar cartilages and creation of an elastic supportive convexity at the dome of the nares.

Physiology. The phenomenon created by narrowed external nares affects the aerodynamics of respiration and reflects itself in varying degrees of alteration in respiratory physiology. When the increase in negative pressure inside the nose during inspiration surmounts the natural resistance to collapse offered by the architecture of the alar cartilages and their associated musculature, the opening of the nares markedly diminishes and then disappears. This situation extends and perpetuates itself and the more effort the patient directs

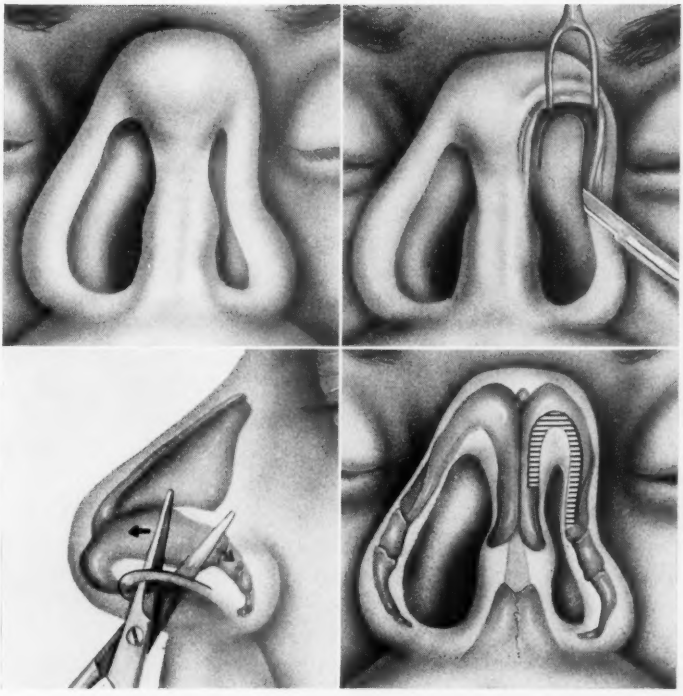

Fig. 1.—Unilateral collapsed nostril.

Fig. 2.—Horseshoe-shaped incision just inside the vestibule of the nose.

Fig. 3.—Mobilization of the tip of the nose.

Fig. 4.—Anterior view of the segment of alar cartilage to be removed.

to breathing through his nose the greater the tendency to collapse becomes. The relative negative pressure established during forced inspiration and the relative positive pressure created during expiration through collapsed nostrils is transmitted to the intrasinus cavities. As a result the exchange of air in these sinus cavities is increased. When the resistance offered is uncomfortable, the patient ultimately becomes a partial or complete mouth breather. Any exertion causing an increased demand upon the respiratory system only exaggerates the phenomenon of collapse because of the increased rate and increased intranasal negative pressure. This leads the patient to interpret this phenomenon of being unable to breathe freely through his nose as being short of breath and unable to catch his breath. Some of these individuals have been misdiagnosed and mistreated for cardiac and respiratory insufficiencies. Eventually, when the patient has become a mouth breather the work load in the nose is diminished and few gross abnormal changes have been noted in the nasal mucosa on the side which presented collapse of the external naris. However, this change from the normal mechanism of breathing through the nose to the abnormal one of through the mouth reflects its deleterious effects upon the pharynx, larynx and lower respiratory systems in that the normal preparation of the air for the lungs is not accomplished.

Surgery. The surgical correction of collapsed nares improves the physical form of the nose, facilitates nasal breathing and enhances normal respiratory physiology. Several techniques have been proposed for the enlargement of abnormally small nostrils.[1-5] These techniques include the lateral transplantation of the lobule over a medially shifted cheek flap and transposition of a rectangle of the lateral wing of the alar cartilage. Other procedures consist of the transection of a wedge of the lateral crura and its associated soft tissue including the entire width at its midportion. Some techniques embrace the excision of wedges of soft tissue about the nostril and the implantation of a free segment of cartilage in the dorsal tip. More recently, mobilization of the tip and readjustment of the local structures have been advocated.[6] Each has apparently worked well for the condition to which it was applied and it should be reemphasized that there is no single surgical technique that will correct all of the various types of tip deformity. Subluxation of the anterior portion of the nasal septum, stenosis of the nares, scar contracture of the nares, loss of tissue due to excision of tumors, congenital deformities of the tip, etc., require individual analysis and

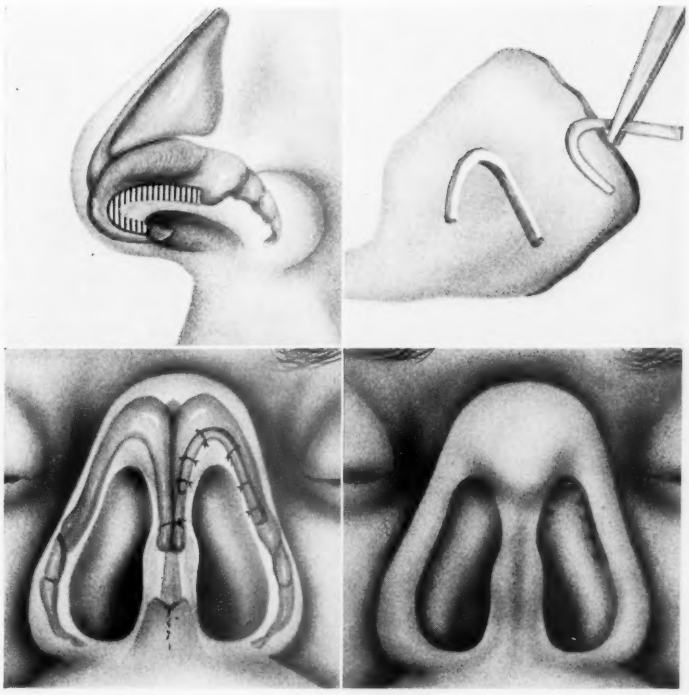

Fig. 5.—Lateral view of the segment of alar cartilage to be removed.

Fig. 6.—Modeled cartilage implant from nasal septum.

Fig. 7.—Implant in position.

Fig. 8.—End-result.

the application of a surgical procedure befitting the needs of that particular case.

The following technique has been satisfactorily applied in the correction of narrowed and collapsed nostrils where the elastic convexity of the dome and the tip is not adequate to maintain a patent inlet valve. It is not recommended for other types of tip deformities. The basic principle of the operation is to supply the needed dorsal convexity and remove any gross obstruction after complete mobilization of the tip. A recipient bed is prepared and a modeled cartilaginous convex support is fixed to the lower portion of the alar cartilage.

Under local anesthesia, 1% procaine with six drops of adrenalin to the ounce by infiltration, the nasal tip is skeletonized through a curved incision just inside the dome of the vestibule (Fig. 1 and 2). The tip of the nose is mobilized (Fig. 3). Any gross deformities of the medial or lateral crus of the alar cartilages or nasal septum are corrected. If the narrowing of the airway is not improved sufficiently by these minor procedures, a rim of the lower border of the alar cartilage, 1-2 mm. in width and 10 mm. in length, is removed (Fig. 4 and 5). By means of a small malleable splint, the exact shape of the new ala is determined by contrast and from this pattern a curved section of cartilage is cut to support the newly formed arch. The donor cartilage is preferably obtained from the patient's nasal septum. If this is impossible, ice-box cartilage may be substituted. This implant is then carefully secured to the cut edge of the medial and lateral crus of the alar cartilage with fine silk or tantalum wire. At least one suture should also secure it to the opposite medial crus (Fig. 6 and 7). The skin wound is then closed with No. 00000 dermal suture and a supportive dressing applied to the nose for one week (Fig. 8). Care should be exercised not to grossly over-correct the collapse because of the resulting distortion in the shape of the tip of the nose.

Three cases demonstrating variations of narrowing of one or both nostrils are presented with clinical and anatomical analysis of the defects and the surgical procedures necessary for their correction.

REPORT OF CASES

CASE 1.—This patient presented congenitally narrowed and pinched nostrils resulting from the development of a small convex

Fig. 9.—Case 1. Before operation.

Fig. 10.—Case 1. After operation.

dome over the vestibule, collapsed alar cartilages and prominent medial crura. The condition was slightly more exaggerated on the left side. The muscular dilating activity of the nostrils was diminished. The gross anatomy revealed acute angulation of the alar cartilages at the domes of the vestibules. The lateral crura were curved medially and the medial crura laterally. However, the alar cartilages were fully developed. The patient complained of inability to breathe through the nose.

To correct this condition a complete surgical mobilization of the tip was effected first. The lower parts of the medial crura were partially amputated. The inner concave portions of the lateral crura were shaved through. The angulations of the alar cartilages in the vestibular domes were relieved by horizontal slitting. After this complete release and mobilization was accomplished, a modeled cartilaginous implant from the patient's septal cartilage was secured as shown in the accompanying illustrations. The tip was immobilized for one week with a splint and dressing (Fig. 9 and 10).

Case 2.—This patient presented narrowed nares without the pinched nose appearance. The tissues about the nares were redundant, soft, and not acutely defined. The vestibular dome was broad but soft and collapsible. The columella was wide and crowded the air inlet. The lateral wings of the alar cartilages possessed normal

shape and size but little effective intrinsic support for the nostril. Redundant soft tissue crowded the nares. The patient complained of shortness of breath and inability to breathe through the nose.

The surgical approach in this instance consisted of mobilization of the tip of the nose, narrowing of the columella, resection of a small section of redundant tissue about the lobules and the implantation of the modeled cartilaginous domes to give support and form to the nostrils.

CASE 3.—This patient presented a condition similar to that in Case 1, but milder in degree. The tip was narrowed but not pinched. The alar cartilages were fully developed but of such contour as to cause marked narrowing of the nares. This was due to prominent medial crura, wide columella, and acute angulation of the alar cartilages in the domes of the vestibules. The lateral crura were normal in shape and size. The patient complained of moderate difficulty in breathing through the nose. This was exaggerated upon effort.

Surgical procedure entailed mobilization of the tip of the nose, then narrowing of the columella, partial amputation of the medial crura, and release of acute angularity in the domes of the vestibules with horizontal cuts in the alar cartilages. The angles of the new nostrils were then supported and fixed by the implantation of the modeled cartilaginous form.

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XXXVIII

DUST THERAPY IN ALLERGY OF THE EAR, NOSE AND THROAT

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Much of the material used in this paper will be recognized as repetition, but I believe there are certain broad fundamental principles in the treatment of allergy of the ear, nose and throat which are of sufficient importance to warrant repeated review and frequent emphasis.

The importance of allergy as an etiologic factor in pathology of the nose, throat and ear is still not universally recognized. The general belief still persists among rhinologists that the great preponderance of nasal symptoms are secondary to infection of the sinuses or of the nasal mucosa itself and that either surgery or persistent treatment with nasal decongestants, the sulfonamides or penicillin will cure most of these conditions. The failure to obtain results is still credited to poor or incomplete surgery, to insufficient local treatment or inadequate treatment with the antibiotics.

As a matter of fact, a careful routine allergic history and an examination of the nasal mucus for eosinophils will frequently show that a high percentage of all nasal symptoms are due to allergy and not to infection, and that even when infection is a factor, an allergic mucous membrane very often is the receptive media upon which secondary infection becomes superimposed. In these cases complete relief of symptoms can be obtained only after allergic control has been established.

The value of a careful allergic history and a routine examination for eosinophils in all patients with nasal symptoms can not be

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overestimated. They are all important in making a differential diagnosis between allergy and infection and in deciding what type of therapy is most likely to be effective. Examination for eosinophils in a patient with nasal symptoms is just as important in making an accurate diagnosis as is a thorough inspection of the larynx in patients with persistent hoarseness or as hearing tests in patients with impaired hearing.

Many ear, nose and throat specialists still fail to recognize the importance of treating their own allergic patients. It is only by observing the results of treatment that one can become allergically conscious and can become proficient in the recognition of these conditions. It has been abundantly proven by cytologic examination that a red, inflamed nasal mucous membrane does not rule out the presence of allergy nor does a pale boggy nasal mucous membrane necessarily indicate absence of infection. In other words, the diagnosis of neither infection nor allergy can be made by inspection of the nasal mucosa alone. I repeat, a complete allergic investigation is the only method of making an accurate diagnosis.

Only by close observation of the changes which occur in the nasal mucosa following allergic management can the effectiveness of the treatment be determined. The rhinologist alone is competent to make these examinations, to adequately watch and evaluate the treatment accurately and to vary the therapy to obtain a satisfactory result.

Until very recently most rhinologists have been reluctant to undertake treatment of allergy of the ear, nose and throat because it was considered most complicated, tedious and time-consuming and the results were frequently unsatisfactory.

During the past few years, however, the methods of diagnosis and treatment have been so improved and simplified, and the time element so reduced that every rhinologist now can and should care for these allergic patients. In fact, the percentage of nasal symptoms caused by allergy is so high that no competent otolaryngologist can hope to escape responsibility for the care of these patients.

Nasal allergy is no respecter of race, color, creed, or age. The very young, the very old, and all ages between may suffer from this disease.

Of all allergens causing perennial nasal symptoms, dust is by far the most important.

Indications for Dust Therapy. Originally the indications for instituting dust therapy were limited mainly to symptoms of impaired breathing and excessive nasal discharge. Over a period of time as methods of treatment improved and the percentage of satisfactory results became higher, it was noted that many other ear, nose and throat complaints disappeared following dust therapy.

Experience has made it apparent that allergy should be considered as an etiologic factor in many symptoms formerly attributed entirely to infection.

Some of the more important symptoms in which allergy should be suspected are: chronic bronchitis, susceptibility to so-called acute head colds, anosmia, frequent sore throat, acute and chronic laryngitis, external otitis, chronic discharge from the middle ear which does not respond to usual treatment, deafness due to edema of the eustachian tube, fluid in the middle ear, certain types of headache and vertigo, acute and chronic conjunctivitis either due to contact dust or secondary to a nasal dust allergy, and a long list of other symptoms not connected with the nose, throat and ear. When allergy is the causative factor, a high percentage of these symptoms are relieved by dust therapy.

Before beginning dust therapy it is assumed that a tentative diagnosis of perennial inhalant allergy has been made based on: (a) an adequate allergic history, (b) a careful evaluation of symptoms, (c) the finding of an increased number of eosinophils in the nasal mucus, and (d) confirmative skin tests when possible.

It is further assumed that contributing etiologic factors such as nutritional deficiencies, food sensitivities, emotional upsets, mental conflicts, psychosomatic influences, endocrine dysfunctions, and seasonal inhalant allergies have been thoroughly investigated and evaluated.

After all of these factors have been considered and proper treatment instituted, attention is next directed to the perennial inhalants, i.e., all inhalant allergens except those specific pollens causing seasonal hay fever.

As in the treatment of all other allergies, the dust therapy for each patient must be on an individual basis. The simplest methods

which give promise of relief are tried first and the more complicated methods are resorted to only after the simpler methods have failed. Procedures may be summarized as follows:

1. Elimination or avoidance of offending allergens (prophylaxis).
2. Hyposensitization by sublingual absorption.
3. Hyposensitization by injection.

Elimination of Offending Allergen. The elimination of the offending allergens is usually not possible; however, an attempt should be made to eliminate, avoid, or minimize contact with the common allergens.

House dust, tobacco smoke, feathers, cosmetics, household pets, occupational dust, Kapok and insecticides are the most common offenders and their avoidance sometimes relieves the patient's symptoms and makes further treatment unnecessary. Elimination of the offenders materially shortens the time necessary for hyposensitization by injection to become effective even in those patients whose symptoms are not entirely relieved by avoidance.

This is particularly true if the patient's sleeping quarters can be made comparatively dust free. Dust proofing of sleeping quarters is one of the most important prophylactic procedures in the treatment of allergies caused by dust.

It has been noted that if the patient suffering with nasal allergy can sleep in a dust free room, his inhalant tolerance can frequently be built up to the point where he can comfortably perform his work during the day, even though he may be in close contact with the offending allergens during his working hours.

An example of this was demonstrated during the last war at a large supply and repair base in the South Pacific. One of the hospitals in that area built an air conditioned dust free ward which was reserved as sleeping quarters for men with nasal and bronchial allergies.

In that area the mold and fungus counts were very high and working conditions were very dusty. By sleeping in the air conditioned ward, many highly trained dust sensitive technicians, who otherwise would have become incapacitated and would have had

to be sent out of the area, were able to continue their important work.

A dust free bedroom should be prepared and maintained as follows:

1. All upholstered furniture, wool rugs, uncovered pillows and window drapes should be removed permanently.

2. The room should be cleaned daily with vacuum or carpet sweeper, not swept with a broom.

3. Curtains should be washed every two weeks.

4. The woodwork and floors should be cleaned with an oil mop once a week.

5. No pets, plants, flowers, woolly toys, cosmetics, insecticides should be allowed in the room.

6. All pillows and mattresses should be encased in dustproof covers.

Besides dust precautions the patient should also be instructed to avoid all nasal drops, inhalers, sprays and irrigations before hyposensitization is begun. Local nasal medication in allergically sensitive individuals usually prolongs the necessity for allergic treatment.

If it is impossible to avoid or eliminate offending inhalants or if prophylaxis fails to relieve symptoms, it then becomes necessary to institute hyposensitization therapy.

From the standpoint of etiology of nasal symptoms, house dust is the most important. Molds, fungi, tobacco smoke and paper are also very frequent offenders and because of their wide distribution are included under the general term "dust."

Occupational, industrial and specific environmental inhalants while not so universally distributed are also important and must be included under "dust." These elements are often added to or given in conjunction with the more common inhalant allergens.

House dust contains many known allergens and some specific allergen the nature of which is unknown. Its chief constituents are: cotton, flax, jute, wool, silk, animal hair, Kapok, orris root, pyrethrum, tobacco, molds and fungi.

According to Hansel,[1] autogenous extracts of dust were employed for many years but it was found that they varied greatly in potency and effectiveness and that they usually contained too much rug and floor dust and an insufficient amount of upholstery dust. He now states that stock dusts or a combination of stock dusts are usually more satisfactory than autogenous extracts, but that specific occupational autogenous dust extracts may be necessary in special cases.

On the West Coast as well as in many other areas of the country, atmospheric molds and fungi are abundant and seem to be very important factors. For this reason we now incorporate an extract of these organisms (Wittich Extract) into our dust mixture in the ratio of one part of Wittich to nine parts of dust.

Hyposensitization by Sublingual Absorption. For the past few months studies have been undertaken throughout the country on this form of therapy. While not enough information has yet been accumulated to draw any definite conclusions as to its effectiveness nor to warrant its general use, the indications are that this form of therapy may prove to be a valuable adjunct to injection therapy.

Hyposensitization by Injection. With the institution of injection therapy the initial dose depends upon the plan of administration to be employed. Two methods are generally followed; namely, the large dosage build-up and the small dosage or high dilution optimum maintenance dosage.

In the first method, initial dose is estimated at a point just below that which gives the smallest skin reaction. This is usually the 1:1,000 or the 1:100 dilution. The concentration of the solution is gradually increased at five to seven-day intervals to the maximum, which not infrequently is the concentrated extract.

By gradually increasing the dosage to the highest point tolerated by the patient, relief is apparently the result of creating a state of refractoriness. While some good results have been reported following this method, it does have certain disadvantages. Prominent among these disadvantages are:

1. Many individuals may be skin negative to certain allergens and yet be very sensitive to the same allergen if it comes in contact with mucous membranes, thus making the skin tests of little value as a basis for determining initial doses.

2. High concentrations frequently resensitize the patient and cause severe and often dangerous reactions.

3. High concentrations often stimulate acute exacerbations of mild chronic symptoms.

Previous to 1938, Hansel[2] employed the large dosage methods, but following some observations on the small dosage treatment of hay fever, he began the application of the plan to dust therapy. Initial doses were reduced to 1:10,000 and 1:100,000, later to 1:1,000,000. In many instances he noted that relief of symptoms occurred after the initial injection, but that effectiveness was lost when the dose was increased. This was the beginning of the plan of optimum maintenance dosage. That is, when satisfactory results were obtained, the dosage was not increased.

Later it was observed that dilutions weaker than 1:1,000,000 were necessary to produce relief of symptoms, so gradually, by repeated observations extending over a period of ten years, the dilutions for initial and effective dosage were reduced to 1:10,000,000 and finally to as low as 1:10,000,000,000.

When the 1:1,000,000 and 1:10,000,000 dilutions were reached, it seemed utterly fantastic that such a small amount of extract could be effective. It became even more fantastic when 1:10,000,000,000 was reached; however, with these dilutions relief was obtained in many patients who had been refractive to treatment when stronger solutions of the antigen were used. Although no immunological proof has been established for the rationale of this type of therapy, clinical results have been so universally good that there can be little doubt as to their efficacy.

Furthermore, the method appears quite logical when one realizes that clinical symptoms are precipitated by dusts and pollens upon the inhalation of extremely small amounts of allergen in terms of amount of extract. Severe hay fever symptoms, for example, may be initiated by the inhalation of 1/100 of a unit of pollen in terms of the amount of extract at the peak of the ragweed season, the patient does not breathe more than two to five units daily and only a fraction of the pollen extract probably reaches the blood stream. We have seen acute attacks of asthma precipitated by as small a dose as 0.05 cc. of a dilution of 1:100,000,000 dust in highly dust-sensitive individuals.

Small dosage therapy, therefore, theoretically at least, should be effective in neutralizing the extract contained or absorbed and in building up some protective immunity. In our hands the low dosage-maintenance dose method has been far more effective than the large dose build up method.

Following is a method of hyposensitization to the perennial inhalants which has proved effective in our practice:

General Therapeutic Suggestions:

1. Establishing the proper size dose is the most important factor in obtaining a result. The dose varies in each individual and we have been struck with the narrow margin between the size dose which will maintain the patient symptom free, and the dose which will aggravate his allergic symptoms. This margin is often as little as 0.1 cc. of a 1:100,000,000 dilution—fantastic, but true.

2. Patients are treated according to symptoms, not according to skin tests.

3. Starting dose is determined according to symptoms; the more severe the symptoms, the smaller the dose.

4. Food sensitive, asthmatic and hay fever patients are usually more sensitive and should be started with an initial dose smaller than average.

5. The dose should be smaller during the hay fever season and during acute episodes.

6. Maintain the dose at the effective point and lengthen the time between injections. "Do not increase when relief is satisfactory."[3]

7. Occasionally symptoms will improve to a point and then remain stationary. This may be due to "tissue fatigue." Resumption of treatment after a rest of three to four months will often be followed by continued improvement.

8. When the patient remains symptom free for three 21-day periods, stop treatment.

Specific Treatment:

1. Antigen used is house dust to which mill molds, fungi and smuts have been added (Wittich's antigen) in proportion of nine parts dust to one part Wittich. (Other inhalants such as tobacco

smoke, paper, animal danders, etc., which may be suspected from history are empirically added.)

2. Dilutions of 1:10,000,000,000, 1:1,000,000,000, 1:100,000,000 and 1:10,000,000 made with coca solution are used. I repeat, these dilutions are fantastically small, but experience has shown them to be effective.

3. Starting dose is usually from 0.1 cc. of 1:10,000,000,000 to 0.1 cc. of 1:1,000,000,000 for those patients with very severe symptoms, for very small children and for asthmatic patients. A starting dose of 0.1 cc. of 1:100,000,000 for those with severe symptoms is used, and 0.1 cc. of 1:10,000,000 for those with milder symptoms.

4. Doses are given twice weekly to start.

5. Doses are increased 0.1 cc. at each dose (after the first dose, 0.1 cc. is given intradermally and the balance subcutaneously), until symptoms are relieved or until 0.5 cc. is given.

6. If improvement is noted before 0.5 cc. is reached, the dose is held to that point and the interval between doses is increased, first to once per week, then to once every two weeks, and finally to once every three weeks. When the patient can go symptom free for three 21-day periods, the treatment is stopped.

7. If symptoms are not relieved on reaching 0.5 cc., 0.1 cc. of the next lower dilution is given and the routine continued. If this dosage causes a flare-up in symptoms, the tendency should be toward lowering the dose. Dilutions of 1:1,000,000,000 or even 1:10,000,000,000 have given relief when stronger dilutions have failed.

8. A dose which aggravates, i.e., increases the nasal stuffiness, increases nasal secretion, or increases the perennial type of cough, is too large and the dose should by dropped back by 0.1 cc.

9. A dose which gives improvement in symptoms but fails to carry the patient symptom free to the time of the next injection is too small, and should be increased by 0.1 cc.

10. Once the effective dose has been determined, maintain the dose at that point. Do not increase when relief is satisfactory.

Reasons for Occasional Flare-ups:

1. Too long between injections before allergy is completely controlled.

2. Contact with an overpowering dose of antigen.

3. Sudden changes in temperature and humidity.

4. Acute infections.

5. Psychological upheavals.

6. Fatigue, both mental and physical.

7. Indiscretions of diet and overindulgence, alcohol and smoking.

Reasons for Occasional Failures:

1. Incorrect or inadequate diagnosis. A running history, i.e., additional questioning at each visit regarding previously overlooked contacts, food sensitivities, etc., is most helpful in preventing or correcting this error.

2. Improper dose, too large or too small.

3. Inadequate treatment of contributing etiologic factors. Food sensitivities, pollen reactions, mental upsets, etc.

4. Overuse of drug therapy which masks symptoms and prevents establishment of proper effective dose.

5. Treatment over insufficient length of time.

6. Hypertrophies due to irreversible tissue changes requiring surgery.

7. Combined allergy and infection, when infection is inadequately treated.

8. Lack of co-operation on part of patient.

Results:

1. A high percentage of allergic patients become symptom free.

2. Symptom free period varies from months to years.

3. If symptoms return, three to five injections are usually all that are necessary to again relieve symptoms.

4. There are no dangerous local or general symptoms as occasionally seen when larger doses of antigen are given. (This is im-

portant; the patient is hyposensitized without danger of local or construction reactions.)

5. Subjective improvement is frequently manifest after a very few injections, often after the first injection.

6. Objective improvement in the appearance of the nasal mucosa is often observed after four or five injections.

7. A high proportion of chronically infected sinuses clear up spontaneously as the underlying allergy is brought under control.

8. Chronic laryngitis, chronic otitis media purulenta, chronic bronchitis and many other secondary symptoms which may have resisted all other methods of treatment often are relieved following dust therapy.

SUMMARY

1. A high percentage of nasal symptoms is due to allergy.

2. Allergy causes nasal symptoms in the very young and in the very old and all ages in between.

3. Many symptoms formerly attributed entirely to infection respond only to allergic treatment.

4. Allergic diagnosis and treatment have been simplified and time required so shortened that all rhinologists can and should treat their own ear, nose and throat allergic patients.

5. Routine examination of the nasal mucus for eosinophils is imperative in making a complete ear, nose and throat examination.

6. A running history frequently brings out important previously overlooked etiologic factors.

7. The proper dose is the most important factor in obtaining a result in injection therapy and the difference between a hyposensitizing dose and a sensitizing dose is often very small.

8. Elimination or avoidance of the offending inhalants is important, particularly dust prophylaxis in sleeping quarters.

9. While house dust is the most important inhalant, of almost equal importance are molds, fungi, tobacco smoke and paper.

10. Important points in dust hyposensitization treatment are:

a. Small doses of very dilute antigen.

b. Build up dose only to point at which relief is obtained, then lengthen time between injections.

c. If symptoms are aggravated, drop the dose.

d. When patient is symptom free stop treatment.

11. Many unknown factors need clarification.

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XXXIX

ARE ANY STRICTURES OF THE ESOPHAGUS DUE TO DIPHTHERIA?

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When collecting cases of strictures of the esophagus following corrosion treated at the Otolaryngological Clinic of the University of Helsinki after 1913, I put aside four cases reported to be due to diphtheria. These cases would probably have received no further notice if the following patient had not, on January 9, 1948, come for treatment at the Outpatient Department of the Clinic:

Case 1.—The patient was a male aged 64 years who related the following: On December 2, 1947, he drank a little fluid believing it to be alcohol, and felt severe burning in the mouth. He immediately spit out, drank a great deal of water and vomited intensely; the vomitus was slightly blood-tinged. After two days he went to a doctor as he was not able to eat. The doctor, who was not told of the accident, said he had diphtheria but that he could not be admitted to hospital because there was no room. Three days later he went to another doctor who thought that "such an old man is not likely to catch diphtheria." After two more days he went to a third physician who regarded it as diphtheria and prescribed accordingly. It became more and more difficult to eat and the man's weight fell in one month from 53 to 30 kg. In a miserable condition he was taken, on January 7, 1948, to a fourth doctor who suspected corrosion due to lye and sent the man to our clinic.

Examination revealed the oral mucous membrane to be fairly thick, covered by a white scar. The margins of the epiglottis and arytenoid areas were edematous and slightly covered by pus, which indicated corrosion. X-ray examination revealed severe strictures at the level of the tracheal bifurcation and the hiatus. There was marked stenosis of the pylorus. Because of his poor general condition the patient was sent to the Surgical Clinic where a gastro-enter-

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ostomy was performed on January 16, 1948. The stomach was contracted, its walls atrophic, the mucous membrane thin as paper, and the lumen of the pylorus completely stenosed.

This case made me think of the differential diagnosis between corrosion and diphtheria. Without the aid of history-taking the possibilities of error in these two diseases appeared very great and it seemed to me that this case observed by me might not be the only one. I decided to go through the cases of corrosion treated at the Otolaryngological Clinic (up to that time, 323 cases), but before that I took from the "wastepaper basket" the four cases mentioned above in order to study them more closely. They are as follows:

CASE 2.—The patient was a 22-year-old male. The clinical report stated that early in February, 1946, he had fever and pain in the neck. On February 6th diphtheria was diagnosed and the patient was treated for two weeks at the Hospital for Epidemic Diseases at Varkaus. The fever was low and of short duration. While he was at the hospital swallowing was difficult, and finally he vomited nearly everything immediately on swallowing. The patient took only fluid food and this did not issue through the nose. He was at home for about two weeks but as the symptoms did not disappear, he was re-admitted to hospital where x-ray examination with a contrast medium revealed that "the food sticks in the chest" and the hypothesis was that the patient had drunk lye. This he denied at the time. There was continuous moderately severe pain on the right in the lower part of the chest at meals and also at other times. The vomitus was slightly mucoid, but never bloody. Bouginage was tried at Varkaus but not even a No. 17 bougie passed through. After about three weeks at the Varkaus Hospital, during which time no improvement was observed, the patient asked to be transferred to Helsinki. He had never had cramps. The bowel was functioning normally. There had been a 16-kg. weight loss.

On examination the posterior part of the palate and pharynx were seen to be reddened throughout, and there were streaks of scars. X-ray films showed two strictures, one at the orifice of the esophagus, the other at the level of the bifurcation.

The following remark has been added to the clinical report: "The patient has later admitted that he drank lye in the beginning of February while under the influence of liquor and was treated at the Hospital for Epidemic Diseases at Varkaus on the wrong diagnosis."

CASE 3.—The patient was a male aged 21. He was first seen on March 26, 1943, as an outpatient. After midsummer in 1940 he had had high fever and was not able to swallow at all. Food did not pass down through the esophagus but did not issue through the nose either. He was admitted at once to the Hospital for Epidemic Diseases at Leppävirta; the diagnosis was diphtheria. In September, 1940, he was transferred to the Provincial Hospital at Kuopio, where gastrostomy was immediately done, and after that, ordinary bouginage, at first with very thin bougies. This treatment was continued after 1943 at the Outpatient Department of our clinic.

The stricture had arisen while the patient was on leave convalescing from an empyema following pneumonia contracted while in the army. The stricture was considered due to military service and the patient received compensation and the training for a new job given to disabled servicemen. On completion of his training the patient came to the Outpatient Department for bouginage on June 17, 1948. Without saying anything about our suspicions as regards the diphtheria, the past history was checked. The patient recalled that a throat sample had been taken at the Hospital for Epidemic Diseases, the disease was said to be diphtheria and after two to three days he had been given antidiphtheritic serum. The patient was sent to our laboratory for a complete blood count and to the X-ray Department for contrast studies of the esophagus and the stomach, but he did not go to either of these places and repeated calls to a new examination were ignored until slight threats were used.

He came on June 19, 1948, and examination then revealed his condition to be as follows: There were artificial dentures in both arches. In the area of the whole soft palate there were streaks of scars resembling striae gravidarium. Esophagoscopy showed at the level of the arch of the aorta a 3-cm. high ring of scar tissue and leukoplakia, as well as a funnel-like stricture in the region of the hiatus oesophageus. After a thorough examination a new history was taken and the patient then admitted with tears that after midsummer in 1940, while intoxicated he drank fluid from a bottle found in a cupboard. On waking in the morning not even water would go down his throat. When he tried to swallow, water did not come out through the nose. He had high fever. When his temperature began to fall after about a week he went to the Hospital for Epidemic Diseases at Leppävirta where the case was diagnosed as diphtheria. He did not know whether a diphtheria sample had been taken. He had no paralysis. He remained at this hospital for two months and was

then transferred to the Provincial Hospital at Kuopio. On being asked whether he considered it possible that the bottle contained a corrosive substance he answered, still with tears, "The doctor will taken.

An inquiry was sent to the Hospital for Epidemic Diseases at Leppävirta. The hospital answered that their diagnosis had, in fact, been diphtheria but no samples for bacteriological study had been know that."

When these cases which had been "definite" strictures due to diphtheria had thus been shown to be definite cases of stricture due to corrosion (lye), there remained only two cases.

CASE 4.—The patient was a girl aged 20. She contracted diphtheria in January, 1938, and it lasted for eight weeks. Serum had been administered. During the second week swallowing became difficult and from that time the taking of any other than liquid food caused difficulties.

Examination on April 12, 1938, revealed that in the upper part of the anterior pillar of the fauces there were scars on both sides. X-ray films with contrast medium showed that the contrast column was uneven from the aortic constriction of the esophagus downwards and its width was 0.5 cm.

CASE 5.—The patient, a 22-year-old female, came to the Outpatient Department on May 26, 1934. She had contracted diphtheria in the beginning of January, 1934. The duration of fever was about four weeks. She was treated at home, but as it gradually became difficult to swallow she was admitted to the Provincial Hospital at Oulu and remained there all February. X-ray studies revealed that the esophagus was narrow in three places: at the level of the larynx, about the middle, and quite close to the stomach. She came to the Otolaryngological Clinic because of difficulties in swallowing, and was sent to the Surgical Clinic for gastrostomy.

To obtain further information we first sent to the patients in Cases 4 and 5 a similar follow-up questionnaire to that used for final elucidation of the cases of corrosion. Both replied to the inquiry quickly. As they lived very far away it was impossible to ask them to come for a follow-up examination. We therefore sent them a letter explaining the uniqueness of their cases and asked them to inform us whether there was any possibility of corrosion and, if not, request-

ing them to describe more closely the circumstances indicating that the disease had been diphtheria.

Only the patient in Case 4 replied to the letter and underlined in the reply card the statement that she was sure she had never swallowed any corrosive substance, but she could give no additional data regarding her diphtheria.

Case 4, accordingly, would be that of an adult having a stricture, as she supposes, after diphtheria, the possibility of corrosion being denied. How much value can be attached to such a denial? First, we can easily imagine the kind of letter-censor the family is for a person living in a remote village. It is too much to require a confession of any possible earlier suicidal attempt. Secondly we have in Case 2 a good example of the headstrongness of patients. A local doctor suspects a stricture due to lye on the basis of x-ray examination; the patient denies it. Presenting himself at the Outpatient Department of our Clinic the following history is given to the assistant physician in the morning: "On the sixth or seventh of last month he drank lye while under the influence of alcohol, the next day went to the doctor who thought it was diphtheria and treated accordingly for two weeks at the hospital." On admission to the Otolaryngological Clinic for treatment he was examined by medical students in the afternoon of the same day, and a new history was taken without seeing the notes made by the medical officer in the Outpatient Department and was entered in the clinical report. This was entirely a history of diphtheria and the possibility of corrosion by lye was even denied on inquiry! Yet the patient admitted before his discharge that he had drunk lye while under the influence of alcohol.

The patient in Case 5 did not avail herself of the opportunity to explain the stricture as due to diphtheria and her silence may thus be taken for an admission of corrosion as was, in a way, her first unqualified answer to the follow-up inquiry.

We thus have five cases which have been regarded as strictures due to diphtheria but in three the patients later admitted that they were caused by a corrosive. In the remaining two cases the diagnosis of diphtheria was made by the patients themselves; the course of the disease was very atypical of diphtheria but it was typical of corrosion, as were the cicatricial changes.

These cases lend no support to the opinion expressed in nearly all papers published on strictures of the esophagus, namely, that diphtheria causes strictures.

During recent decades there have been many very widespread epidemics of diphtheria in Finland. The Otolaryngological Clinic has received during this time practically all the most severe cases of strictures, and during the last few years a considerable proportion of all cases of corrosion and stricture occurring in Finland have also been treated there; nevertheless this material includes no single case of stricture definitely due to diphtheria.

After investigating these five cases I proceeded with great interest and a little scepticism to study what is stated in the literature regarding diphtheria of the esophagus and strictures due to diphtheria.

The former is not a common disease. In the world literature isolated cases are continually reported, less than one per year. Stupka's publication[19] in 1922 has been most often referred to, and deals with diphtheria of the esophagus and its sequelae (cicatricial stenosis). The author reviews a total of 34 cases of diphtheria of the esophagus published by 24 writers during 1821-1917, adding two cases of his own. In 28 of these 34, diphtheria bacilli were not even sought; during 1896-1917 (Löffler discovered his bacillus in 1884) postmortem diphtheria samples were obtained in six cases, one was negative (in spite of this the case was regarded as a sure case of diphtheria!), five native samples were positive and in one of these culture yielded a species of diphtheria bacillus of which the pathogenicity was not studied.

Spitz[18] reviews all 36 cases published by Stupka and adds to them 11 cases in a period of 100 years: in these, "real diphtheria" was noted both in the esophagus and in the stomach, and, also in a period of 100 years, 43 cases of "real diphtheria" in the stomach. In three of the 11 cases mentioned first a diphtheria bacillus was found but culture was positive in only two; the samples were obtained postmortem and pure bacteria were not isolated on culture, tests of virulence being therefore impossible.

In the few cultures in Stupka's series Löffler's method was probably applied, as no other was in use at that time. Rantasalo[15] has demonstrated the unreliability of ordinary Löffler serum. Even with the present methods (Clauberg) a considerable number of atoxic

diphtheria bacilli are found which are at least not generally regarded as causative agents of diphtheria.[15]

Diphtheria is characterized by the formation of fibrinous false membranes in the area affected. In dealing with scarlatinal diphtheria or, more properly, scarlatinal diphtheroid, Fraenkel[7] stresses the fact that the tissue necrosis seen in this disease involves the deep layers of the epithelium and is due to streptococci, thus differing from the superficial membrane caused by Löffler's bacillus.

Most of these 36 cases of "diphtheria" of the esophagus (among them one case with a history of corrosion) showed false membranes and ulceration present in only five. It is a different matter how much importance can be attached to these ulcers noted on postmortem examination when it is known that in none of the cases have postmortal digestive and other changes been excluded, for instance by fixing the esophagus and the stomach according to the method of Faber and Bloch.[6]

Also, how much value may be attributed to the fact that there are membranes in the esophagus and diphtheria bacilli are found in these membranes? Wright,[20] and Schödel[17] have found highly virulent diphtheria bacilli on completely intact mucous membrane of the stomach on postmortem examination in cases of pharyngeal diphtheria. It is also otherwise known that the diphtheria bacillus may be found on completely healthy-looking mucous membrane. Would the diphtheria bacillus then avoid a mucous membrane damaged by corrosion? It does not do so. On the contrary, children who have swallowed lye are particularly susceptible to diphtheria: infections among them have been described and therefore Salzer,[16] for instance, inoculates "all children" against diphtheria.

Among the cases treated at the Otolaryngological Clinic of the University we also find examples which show that diphtheria may occur in connection with corrosion. The following cases with positive cultures may be described here:

CASE 6.—The patient was a boy aged six with an untreated stricture of one year's duration. The referring physician explained the neglect of treatment by stating that the child had been suffering from diphtheria ever since the corrosion and this had prevented bouginage for one year.

CASE 7.—A boy aged three was at the hospital at the same time as the former case. There was corrosion of one year's duration,

due to lye. On November 24, 1945, bacillosis diphtheria faucium without any clinical signs was diagnosed.

CASE 8.—The patient was a boy aged four, with corrosion due to lye. Diphtheria faucium was noted on June 3, 1946.

CASE 9.—The patient was a girl aged three, with corrosion of one year's duration, due to lye. Diphtheria faucium was noted on June 11, 1946.

CASE 10.—The patient was a girl aged two, with corrosion of 12 days' duration, due to lye. Because of Cases 8 and 9, a routine examination for diphtheria was performed. Bacillosis diphtheria without clinical manifestations was noted.

CASE 11.—The patient was a girl aged three, with stricture of half a year's duration, due to lye. Diphtheria faucium was noted on July 4, 1946.

CASE 12.—The patient was a girl aged five, with a 3-year-old stricture due to lye. Diphtheria faucium was noted on September 16, 1946.

The following are cases illustrative of the difficulty of diagnosis:

CASE 13.—The patient was a girl aged two, with corrosion of one month's duration, due to lye; both at our Clinic on August 12, 1947, and later at the Municipal Epidemic Hospital of Helsinki the pharyngeal changes were regarded as diphtheritic, until bacteriological studies disclosed that it was a case of common angina lacunaris.

CASE 14.—The patient was a boy aged five, with a stricture of one month's duration due to a corrosive. In the acute stages two doctors had considered the disease a curious kind of tonsillitis, until the history of corrosion was clear.

I have here dealt extensively with diphtheria occurring in connection with corrosion because rare cases are reported of diphtheria with positive findings of bacteria (e.g., Brandt;[2] how the bacteria were found is not stated) in which a stricture develops later, and I have tried to show that the finding of a diphtheria bacillus does not justify immediate diagnosis of postdiphtheritic stricture.

At least in the early stages the past history is of decisive importance in diagnosing corrosion. We do not always get a reliable past history: children may have been alone when the accident occurred; the parents pretend ignorance so that they should not be accused of carelessness. Those who have drunk a corrosive substance taking it for alcohol are ashamed to tell the truth, and so are those who have attempted suicide. During a period when, and in countries where, corrosion is infrequent, doctors may entirely forget this possibility. The possibility of diphtheria is not so readily forgotten, and corrosion may thus be mistaken for diphtheria, as shown by the cases described above.

I do not wish to contend that diphtheria may not occur in the esophagus. Yet one circumstance attracted my notice in Stupka's series: of 34 cases regarded as diphtheria on very slight grounds, over one-half were under ten years of age. The series of 323 patients treated for corrosion at our Otolaryngological Clinic included 63% under ten years of age. In Stupka's series, 16 were males and 9 females (the sex of nine patients was not communicated). He quotes Heubner's extensive statistics[11] according to which the incidence of diphtheria is 23.4% for boys and 25.2% for girls and wonders at the male predominance in his own series. He tries to explain it by the generally higher mortality rate for the male (Stupka's cases were all diagnosed at autopsy), but he is not able to give any definite figures as regards diphtheria. In the corrosion material of the Otolaryngological Clinic in Helsinki the ratio of men and women was almost exactly 16:9 (206 men to 117 women). The age and sex distribution of the cases regarded by Stupka as diphtheria is thus exactly equal to that in our cases of corrosion. Unfortunately no definite data are available to show whether the ratio in other countries is similar to ours.

Owing to the small number of Stupka's cases this curious coincidence, of course, does not in any way prove that they were all due to corrosion, but as he himself considers these ratios important and tries to treat them mathematically, it may be reported as a curiosity.

In diphtheria the false membrane loosens and the underlying tissue regularly heals without scarring.[9] But for a stricture of the esophagus to develop there must be cicatricial contraction.

In the literature from the period 1860-1912 Stupka has found nine cases of "postdiphtheritic" cicatricial stenosis and he adds two cases of his own, which makes a total of 11.

In this list it arouses attention that none of the cases were submitted to bacteriological study, in four cases the "diphtheria" was diagnosed by relatives and had occurred in childhood, often years before coming to the doctor, two cases had co-existing scarlet fever, in one case practically nothing is stated of the past history, physical examination or course of the disease, and in one a stricture had scarcely been present. One patient is reported to have had white streaks of scars in the pharynx. One of Stupka's own patients, a servant girl aged 20, had, according to her own statement, suffered from diphtheria two years earlier twice at an interval of a few months, and another, a boy of five, had had white membranes in the throat and on the tongue two years previously and the relations supposed it had been diphtheria. On the basis of the nine cases Stupka regards it as highly indicative of diphtheria that the strictures avoided physiologically narrow places, which are the most frequent sites of strictures due to corrosion, and he connects this circumstance with the aerophil properties of the diphtheria bacillus. Yet in his cases there occurred two strictures at the orifice of the esophagus, one at the aortic constriction and two at the hiatus; on the other hand we know that strictures due to corrosion are not necessarily located in physiologically narrow places but often between them (e.g., Leegaard[13]).

Stupka considers these 11 cases definite strictures of the esophagus due to diphtheria.

In view of the extreme rarity of the condition I consider that a stricture of the esophagus should fulfill the following conditions before it can be attributed to diphtheria:

1. The possibility of corrosion or any other factor causing strictures (e.g., typhoid fever: Clerf,[4] Fromme,[8] and Vinson[21]) must be excluded.

2. The diphtheria must be verified by bacteriological culture and preferably the bacteria proved to be pathogenic by animal experimentation.

3. The postdiphtheritic stricture must be diagnosed on clinical examination (by x-ray or esophagoscope) or at autopsy.

Of Stupka's 11 cases none fulfills these requirements.

Since the time of Stupka and Spitz some "postdiphtheritic" strictures of the esophagus have been published. Bacteriological

studies in such cases have been extremely rare and even then the reports are characterized by the reasoning "post hoc, propter hoc," a reasoning which leads to the publication by Vinson[22] of 13 cases in which he attributes a stricture to vomiting during pregnancy, and to the description by Imperatori[12] of a stricture following appendectomy.

Two decades ago Clerf[5] (1926) read a paper on the causes of severe chronic stenosis of the larynx (so-called canulards, cannula bearers), and diagnosis and treatment in these cases. He found that such stenosis was in most cases due to wrong intubation or too high tracheotomy (the same was stated by Bardy[1] in Finland in 1920) and concluded that laryngeal stenosis due to diphtheria is far rarer than toxic paralysis of the esophagus and a stenosis of the esophagus due to an actual diphtheritic ulcer in the esophagus or to decubitus ulcer.

The experience of our Clinic agrees with Clerf's opinion that postdiphtheritic stenoses of the larynx are not due to cicatrization following diphtheria but to improper operative technique.[13]

It is hoped that this study will show that cases of "postdiphtheritic stenosis of the esophagus" observed hitherto are attributable to deficient and faulty diagnosis.

SUMMARY

Five cases are described of esophageal strictures which had been regarded as postdiphtheritic but of which three were definitely found to be due to corrosion (lye) on closer examination. In the remaining two cases the diagnosis of diphtheria was based on the patient's own assumptions; the course of the disease and the sequelae are indicative of corrosion. The importance of a positive culture of the diphtheria bacillus in cases of corrosion and stricture is discussed. The strictures of the esophagus reported in the literature as "definitely" due to diphtheria are reviewed and the conclusion formed that no single case can be definitely attributed to diphtheria.

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XL

TUBERCULOUS LARYNGITIS AND TRACHEOBRONCHITIS

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Tuberculosis of the larynx, trachea, and major bronchi occurs much more frequently than is generally appreciated. This is due to the fact that many such lesions are so situated as to be asymptomatic, and thus examinations are deferred until further developments demand them. The virtue of making such examinations routinely should be apparent; and the virtue lies not in the detection of such lesions per se, but in the implications they lend toward the management of the patient.

The comparative frequency of occurrence of these lesions is attested to in the following reports: gross laryngeal lesions were discernable in 15.5% of 3,227 tuberculous patients reported by Looper and Schneider[1] in 1928; the senior author,[2] in 1948, reported a second series of 2,770 patients with only 7.7%; similar lesions were reported by Myerson[3] in 1944, as comprising 10.6% of 10,657 tuberculosis patients. Bronchial disease, on the other hand, as reported by Sweany and Behm[4] in an autopsy study of 667 tuberculous patients, was present in 377 or 56.5% of the patients as gross bronchial lesions, and in 37.5% of the remainder as histologic lesions of mucosal tuberculosis—a total of 72.0%.

The etiology of these complications is, of course, the tubercle bacilli, present in the infected secretions of the pulmonary lesion. Dissemination of this exudate throughout the tracheobronchial tree lessens the concentration of tubercle bacilli, thereby reducing its infectiousness as it approaches the larynx. It is reasonable to infer, then, that the earliest lesions should be found closest to the source of infection. Such actually is the case: bronchial lesions are noted more than three times oftener than those of the larynx. Similarly, the

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associated edema, ulcerations and granulations of tuberculous bronchitis, acting as obstructive phenomena, are of far greater significance in the control of the pulmonary disease than are the same lesions occurring in the larynx. For these reasons, then, the consideration of tuberculous laryngitis should be relegated to a position of secondary importance as compared to tuberculous bronchitis. An appreciation of this fact is essential if we are to evaluate the effectiveness of the various agents employed in the therapy of tuberculosis of the larynx and tracheobronchial tree.

Although claims of specificity have been made, the therapy of tuberculosis of the larynx and tracheobronchial tree has been highly empirical. The measures employed have consisted of chemicals, such as trichloracetic acid, chaulmoogra oil and silver nitrate; of the newer drugs, promin and penicillin; of physical agents, quartz light, radium and the roentgen rays. Electrocautery has been used extensively in laryngeal tuberculosis, and in the hands of some operators has met with moderate success. Looper and Lyon,[2] although enthusiastic proponents of this means of treatment, repeatedly state that regardless of the type of laryngeal lesion there will be little improvement effected by cauterization in patients with associated excessive exudate. In a controlled group of cases, Black and Bogen[5] conclude that penicillin is effective in controlling secondary infection, and is of value only in those instances in which streptomycin is not available. Lukens,[6] an initial investigator in the use of chaulmoogra oil, feels that whatever benefits have been derived from it have not been because of the specificity of the agent alone. Therefore, it appears that no matter how diverse and varied the nature of these agents, the limitation of their field of application has been responsible for a uniformly low percentage of cures.

Streptomycin. The literature indicates a universal acceptance of streptomycin as being responsible for radical changes in the management of tuberculous patients. Results of experimentation and clinical investigation defining its suppressive action on the course of certain types of pulmonary tuberculosis are remarkable.[7] In the few years since Feldman and Hinshaw[8] published the first report concerning its use in man, the concensus in the literature acclaims it to be the most effective therapeutic agent thus far applied to the treatment of tuberculosis and its complications. In particular, the acceptance of streptomycin as an effective antibiotic in the therapy of tuberculous laryngitis and bronchitis has established a precedent: never before has the healing of ulcerations and the dissolution of granulations occurred with such rapidity. Although this antibiotic

is universally accepted its toxic effects are recognized, and are objectively, as well as subjectively, manifest; in no sense is it offered as a cure for tuberculosis.

Toxicity. In a recent paper,[9] toxic reactions were summarized as follows: "The most serious is a histamine-like reaction, probably

TABLE 1.
SIGNS OBSERVED IN TUBERCULOUS TRACHEOBRONCHITIS

	No.	%
BRONCHOSCOPIC: 44 patients		
Localized Ulcerations	9	20.4
Diffuse Ulcerations	23	52.2
Inflammatory Stenosis	12	27.2
ROENTGENOGRAPHIC: 18 patients		
Atelectasis	4	22.2
Ballooned Cavities	14	77.7

due to protein impurities and rather uncommon in the more recent issues of the drug. Sensitization symptoms are not infrequent, nor are those of renal failure in patients with known renal dysfunction. Involvement of the cochlea and labyrinth have been the most distressing toxic manifestations heretofore; modifications in total daily dosage have lessened their incidence. Of equal consequence, but less well appreciated, is the development of streptomycin-resistant strains, occurring in instances of prolonged administration. Recent reports indicate that this, rather than being an acquired trait, is the 'survival and multiplication of a small number of inherently resistant organisms'." Based on the experiences gained through this study, and enhanced by those of others[10] drawn from the literature, the incidence of toxic manifestations is now of negligible consequence. Except in the occasional sensitive individual, the regime of low daily absorbable dosage has effectively resulted in the alleviation of these untoward reactions.

Clinical Study. In an initial report[9] concerning the use of streptomycin in tuberculous tracheobronchitis, the results obtained in the incidental presence of tuberculous laryngitis were intentionally withheld. Review of the data concerning this factor, particularly in view of the recent literature[10-12] on laryngeal tuberculosis, appears to be of sufficient significance to warrant this second report.

In the original study the incidence of the signs observed, both bronchoscopic and roentgenographic, is reported in Table 1. Sixty-two patients were selected for study, 44 satisfying the bronchoscopic requirements of persistent ulcerations, granulations, and stenoses; and 18 additional evidencing roentgen signs of bronchial obstruction as seen in atelectasis or in the ballooning of cavities.

TABLE 2.
RELATIVE INCIDENCE OF TUBERCULOUS LARYNGITIS IN TUBERCULOUS TRACHEOBRONCHITIS

	No.	%
Bronchoscopically Positive		
(44 patients)	24	54.5
Roentgenographically Positive		
(18 patients)	3	16.6

The incidence of laryngeal disease, as depicted in Table 2, indicates the relative degree of infectiousness of the two groups, and illustrates the virtue of control of the source of infection, as noted by the few cases of laryngeal disease in the group representing bronchial obstruction. The 27 cases so selected represent lesions of moderately advanced or far advanced tuberculous laryngitis. These include ulcerations, granulations, and bulbous edematous lesions with or without associated infiltrating stenoses. The early or minimal lesions of tuberculous laryngitis are omitted because of the possible confusion they would imply in the evaluation of the results obtained. Thus, 5 patients received streptomycin by aerosol alone, 7 by concomitant aerosol and parenteral administration, and 15 by parenteral administration alone. The aerosol solution consisted of 50 mg. of the drug in 1 cc. of sterile isotonic sodium chloride solution, administered by nebulization every two hours, for a total daily dosage of 500 mg. Parenteral administration consisted of the intramuscular injection of 500 mg. twice daily.

RESULTS

Of signal importance in the evaluation of the results obtained by the use of streptomycin in tuberculous laryngitis and tracheobronchitis is a consideration of the element of time. In the prelim-

inary dissertation concerning the effectiveness of the various other agents employed in the therapy of this disease, and as has been accepted generally, the time spent in treatment has been gauged in multiples of years. This report, as with the majority in the literature, is based on the results obtained following the administration of streptomycin for only 90 to 120 days, a fraction of the time previously consumed.

TABLE 3.
RESULTS OF STREPTOMYCIN THERAPY IN TUBERCULOUS TRACHEOBRONCHITIS

Patients Selected Bronchoscopically				
	Concomitant Parenteral and Aerosol	Parenteral Alone 2 gm./day	1 gm./day	Aerosol Alone
Healed	9	4	5	1
Improved	1	2	9	6
Unimproved	0	0	4	3

TABLE 4.
RESULTS OF STREPTOMYCIN THERAPY IN TUBERCULOUS LARYNGITIS

	Concomitant Parenteral and Aerosol	Parenteral Alone 2 gm./day	1 gm./day	Aerosol Alone
Healed	6	4	6	1
Improved	1	1	2	2
Unimproved	0	0	2	2

Of equal importance, as is represented in Tables 3 and 4, is a consideration of the methods of administration. Although the results generally have been impressive,[13] the necessity for adequate dosage is primarily emphasized. The aerosol method affords insufficient dosage, with uniformly poor results. The parenteral method of administration, using 1 gm. per day, has resulted in improvement in a majority of cases, with absolute cure of the laryngeal lesion in 6 out of 10 patients. The larger parenteral dosage, 2 gm. per day, afforded a likewise high incidence of cure but also a coincident high incidence of toxic reactions. The combination of parenteral and aerosol methods of administration appears to be the most effective, both as to the incidence of cure and as to the rapidity of response.

SUMMARY

A second report of the effects of streptomycin in tuberculosis of the larynx, as well as of the tracheobronchial tree, is submitted.

Review of the agents employed prior to the advent of streptomycin indicates their lack of specificity; this is based on the limitation of their application, and on the fact that none of the agents is instrumental in controlling the source of infection.

Evaluation of the results obtained by the use of streptomycin in tuberculosis of the larynx and tracheobronchial tree shows it to be the most effective therapeutic agent thus far employed.

The combination of parenteral and aerosol methods of administration appears to be the most effective, both as to cure and as to the rapidity of response.

255 SOUTH 17TH STREET.

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XLI

THE TOXIC EFFECT OF STREPTOMYCIN ON THE EIGHTH CRANIAL NERVE

HISTOLOGICAL INVESTIGATIONS

A PRELIMINARY REPORT

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OSLO, NORWAY

Streptomycin is primarily valued for its importance in the treatment of tuberculous diseases. For a maximum therapeutic effect to be produced, treatment with large doses must generally be continued over a prolonged period. The toxic potentials of the drug therefore play an important role whenever streptomycin is administered.

By the dosage commonly used, the most frequent complication is a disturbance of vestibular function. Impairment of hearing may occur in rare instances. Streptomycin apparently affects the eighth cranial nerve specifically and the vestibular component in particular.

Numerous publications concerning observations on clinical material as well as animals show that a vestibular dysfunction is frequently produced following prolonged treatment with larger doses. Impairment of hearing, on the other hand, has seldom been observed. Fowler[1] observed impairment of hearing in three of 130 patients in whom vestibular disturbances developed.

The following problem still remains an open question: What is the actual site of the lesion responsible for the vestibular dysfunction and for the much rarer impaired hearing?

A couple of histological investigations have appeared in the literature, which have given only negative results.[2, 4] Stevenson, Alvord, and Correll[3] found in a few dogs changes in the ventral cochlear nucleus but not in the vestibular nuclei. The most important investigation upon the problem is that of Floberg, Hamberger and

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From the Anatomical Institute of the University of Oslo.

Demonstration at a meeting of the Norwegian Medical Society, May 25, 1949.

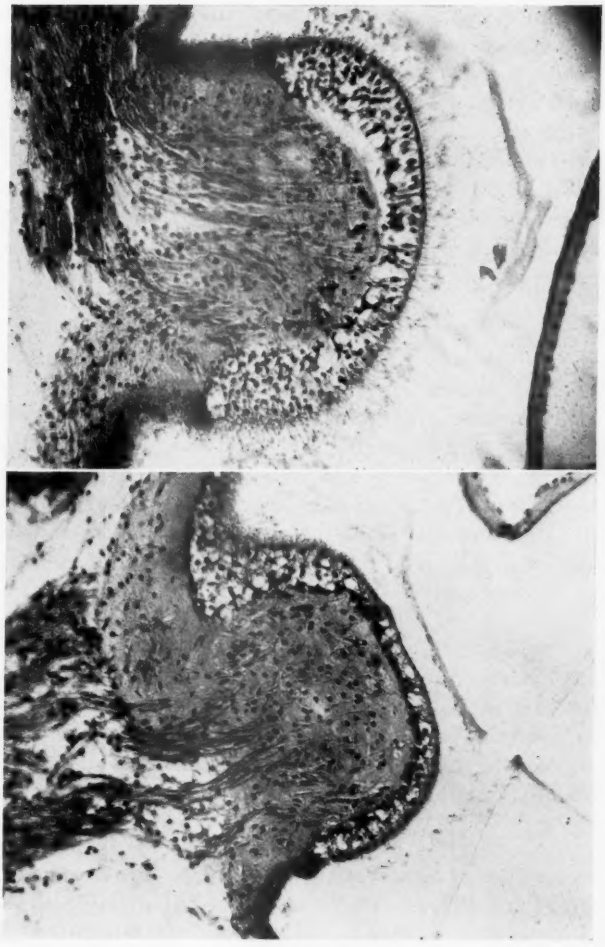


Fig. 1.—Photomicrograph showing normal crista ampullaris of the anterior semicircular canal. (x190)

Fig. 2.—Photomicrograph showing pathologic crista ampullaris of the anterior semicircular canal. (x190)

Hydén.[5] They administered streptomycin to guinea pigs and for their studies employed quantitative cytochemical methods (outlined by T. Casperson) including photography of the cells under ultraviolet light, and microspectrography. They found that streptomycin produces disturbances of the intracellular chemical processes of the nerve cells. The most marked changes were found in the vestibular ganglion and less noticeable changes in Deiters' nucleus. The authors concluded that streptomycin seems to exert an elective action on the nerve cells of the vestibular pathways.

These experimental investigations have been performed with the foremost aim of determining which structures are primarily affected by streptomycin.

Material. Young cats are employed for the experiments. So far 25 have been used, of which 5 were controls. Subcutaneous injections of streptomycin in varying doses were administered once or twice daily over varying periods. The individual animals thus received highly varied amounts. The total dose administered was the equivalent of between 156 and 965 gm. in an adult human being weighing 70 kg. The duration of the treatment ranged from 14 to 127 days. All animals except three were killed at the conclusion of the treatment. The remainder were killed five months later. The findings in these animals will be presented in a later paper.

Testing of the Vestibular Function. The vestibular function was tested at regular intervals by a rotatory test in a rotation chair. The duration of the postrotatory nystagmus was recorded. In all animals the postrotatory nystagmus finally became extinct. The time required for this varied according to the total amount of streptomycin administered, though some individual variations were observed.

Preparation of Specimens. The animals were anesthetized with chloroform and killed. The brain was fixed in 96% alcohol, embedded in paraffin, sectioned, and stained with thionin and Bodian's silver impregnation. In most instances the vestibular ganglion of one side was removed from the meatus acusticus internus, fixed and stained in the same manner as the brain. The other temporal bone was fixed in Wittmack's fixation fluid and decalcified in Wittmack's decalcification fluid after the basal coil of the cochlea and the vestibulum had been opened. Following embedding in paraffin sections were cut at 10 microns and stained with hematoxylin-eosin, Bodian's silver impregnation, and Benda-Spielmeyer's myelin sheath stain.

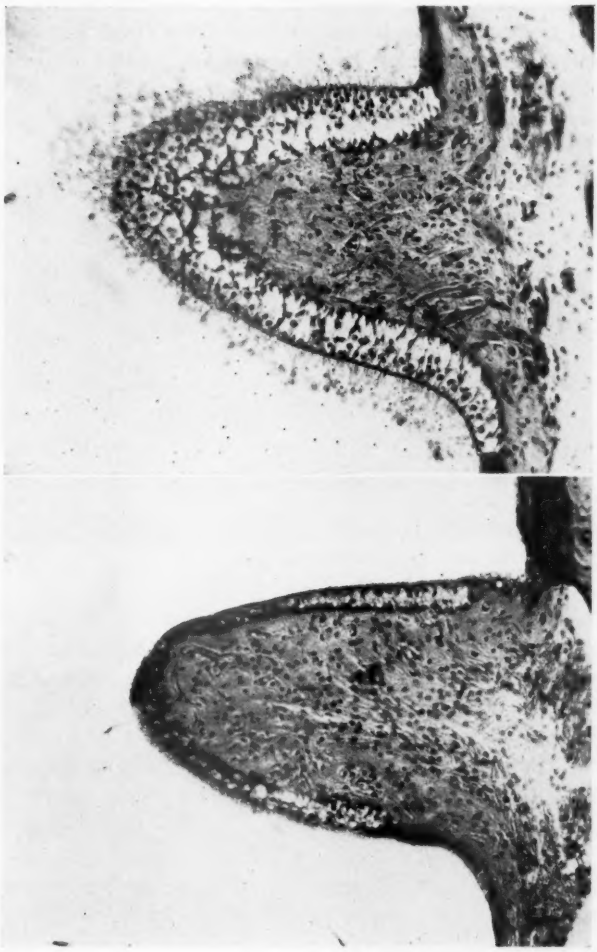


Fig. 3.—Photomicrograph showing normal crista ampullaris of the lateral semicircular canal. (x190)

Fig. 4.—Photomicrograph showing pathologic crista ampullaris of the lateral semicircular canal. (x190)

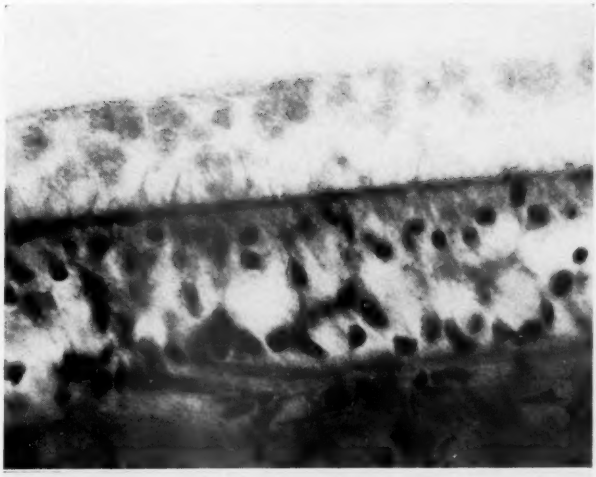
Results of the Histological Examination. Figure 1 is a section from a normal animal showing the crista ampullaris of the anterior semicircular canal. The sensory organ is composed of two types of epithelial elements. It contains an outer layer consisting of a series of sensory cells with a clear cytoplasm and numerous long cilia. Between these cells there are bottleshaped supporting cells with basally situated nuclei.

Figure 2 shows the corresponding crista ampullaris from an animal which has received large doses of streptomycin. A total dose roughly equivalent to 560 gm. in an adult human being was administered over 14 days, i.e., an extremely large dose. The postrotatory nystagmus was extinct at the time the animal was killed. Marked ataxia was present so that the animal swayed from one side to another and had difficulties in remaining on its feet. The section shows marked degenerative changes of the sensory epithelium which, normally a columnar epithelium, is now flattened and composed of mere remnants of highly shrunken, degenerated, rounded sensory cells. The nuclei of the supporting cells are displaced basally and form a continuous narrow brim close to the basement membrane. Another remarkable feature is the total absence of cilia. The same marked changes are also seen in the other cristae.

Figure 3 shows a normal crista ampullaris of the lateral semicircular canal. Figure 4 shows the corresponding crista ampullaris in a cat which, during the course of 127 days, received a total dose roughly equivalent to 960 gm. in an adult human being. This is a comparatively large dose. The changes in this case are even more marked than in the previous animal (Fig. 2). The sensory cells have disappeared almost completely, particularly towards the apex of the crista.

Pathological changes similar to those in the cristae ampullares are also found in the sensory epithelium of the macula utriculi and macula sacculi.

Figure 5 shows a normal macula utriculi. Figure 6 shows the corresponding epithelium in an animal which had received heavy doses of streptomycin. (The same animal as in Fig. 4. Total dose was equivalent to 960 gm. over 127 days.) The sensory epithelium is degenerated, the remaining cells being vesicular with sickle-shaped, excentrically displaced nuclei. The nuclei of the supporting elements form a narrow brim lining the basement membrane.



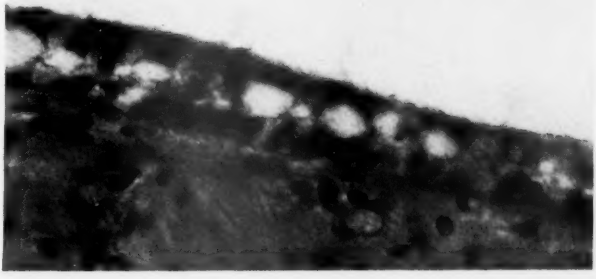


Fig. 5.—Photomicrograph showing normal macula utriculi. (x640)

Fig. 6.—Photomicrograph showing pathologic macula utriculi. (x640)

The specimens in Fig. 5 and 6 are both from animals of the same litter and killed at approximately the same time.

Pathologic changes of the sensory epithelium were present in all of the eight streptomycin animals in which the labyrinth was examined.

In accordance with clinical experience the organ of Corti was normal in seven of these labyrinths. However, in the animal which had received the largest dose, roughly equivalent to 960 gm. in an adult human being, administered over a period of 127 days, the organ of Corti was the site of considerable changes.

Figure 7 shows the organ of Corti in a normal animal. The external and internal hair cells, Corti's canal and the cells of Deiters, Claudius and Hensen, stand out clearly.

Figure 8 shows a definitely pathologic organ of Corti. The sensory cells are entirely lost, and the organ merely consists of large, vacuolated cells lining the basement membrane. These changes are present in the middle coil and towards the basal coil. It cannot be definitely stated whether or not this animal was completely deaf, but the animal's reaction to high metallic sounds, etc., indicated at least a considerably reduced hearing.

The histological examination of the brain and especially the vestibular nuclei did not disclose definite pathological changes distinguishable with the usual staining methods.

In the vestibular ganglion of some of the streptomycin animals the Nissl substance of the ganglion cells had a dust-like appearance. These changes, however, were slight and in no way comparable to the marked changes in the sensory epithelium of the labyrinth.

CONCLUSION

On the basis of the histological findings presented above it is concluded that streptomycin primarily affects the sensory epithelium of the labyrinth. The changes described by Floberg, Hamberger and Hydén[5] in the vestibular ganglion and in the nucleus of Deiters, presumably are secondary to the primary lesion of the sensory epithelium.

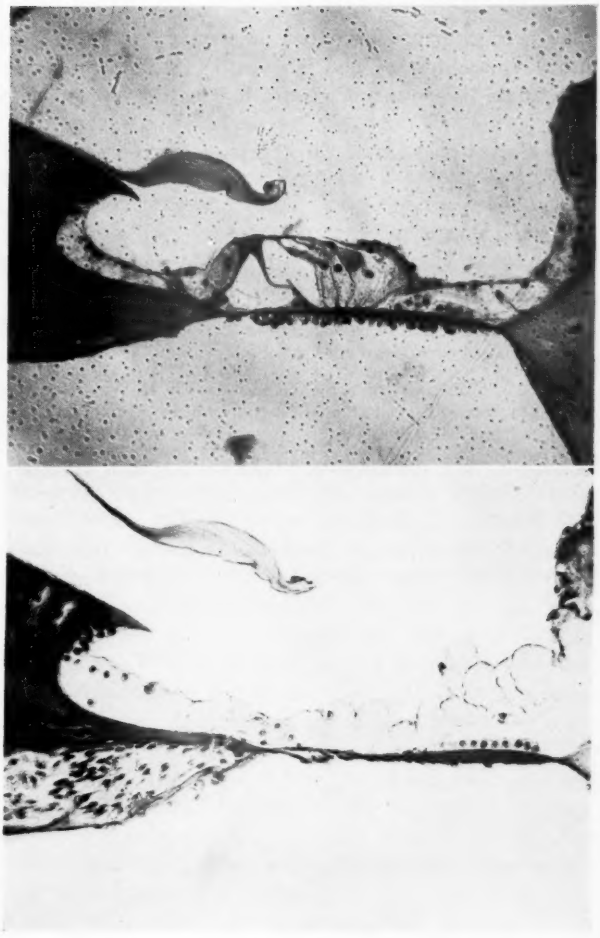


Fig. 7.—Photomicrograph showing normal organ of Corti. (x240)

Fig. 8.—Photomicrograph showing pathologic organ of Corti. (x240)

SUMMARY

The toxic effect of streptomycin on the vestibular apparatus has been investigated experimentally in 25 cats.

It has been clearly shown that the primary lesion is localized in the sensory epithelium of the labyrinth. Slight, presumably secondary, changes have been demonstrated in the vestibular ganglion.

Degenerative changes of the organ of Corti were found in one animal.

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XLII

CYSTS ON THE BASE OF THE TONGUE IN INFANTS

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Respiratory obstruction in an infant is a not uncommon occurrence and its causes may be varied. A cyst of the base of the tongue, by pressing on the larynx, may cause death. Although rare, these cysts should be recognized as an entity, since the measures necessary to alleviate the associated symptomatology are simple and may be life-saving.

In a discussion of cysts of the base of the tongue, a knowledge of the anatomy and embryology of the part is essential to a clear understanding of their development.

Embryology. Beginning with the fourth week of embryonic life, the tongue primordia begin to appear, and in four or five additional weeks the tongue has attained its definitive shape. Its development may be described as a sac of mucous membrane, which becomes filled with growing muscle.[18] The mucous membrane and muscle have entirely separate origins. Of the muscular development not too much is known. It is presumed to arise from posterior metameric musculature of the head region, this muscle growing forward into the tongue, dragging its nerve with it.[10]

As early as the fourth week, two paired lateral lingual swellings are apparent on the inner surfaces of the mandibular arches. Between their medial ends is an unpaired elevation, known as the tuberculum impar. Caudad to this, and between the medial ends of the pairs of the second and third arches, is the copula. There is a deepening midline pit between the tuberculum impar and the copula. This becomes the foramen caecum and marks off the first arch level from the second arch level and, in later life, marks off the body from the root of the tongue. Distal to the foramen caecum, the mucous membrane is derived from ectoderm; proximal to it, the tongue is covered by entodermal derivatives[18] (Fig. 1).

From the Department of Laryngology and Broncho-Esophagology, Jefferson Hospital, Philadelphia, Pennsylvania.

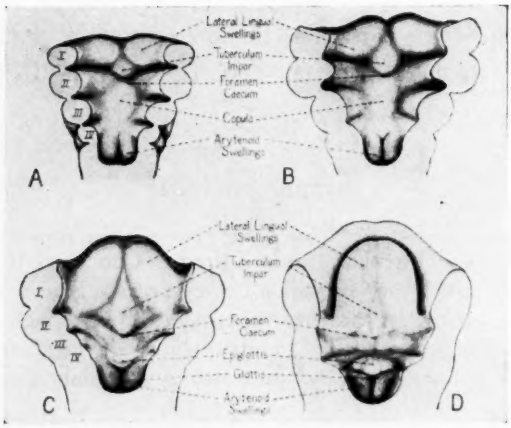

Fig. 1.—Four stages in the development of the tongue (from Patten[18]). The upper part of the head has been cut away to permit viewing floor of oropharyngeal region from above.

I-IV—Branchial arches.

A. Four-week embryo (4-5 mm.)
B. Late fifth week (6-7 mm.)
C. Early sixth week (8-9 mm.)
D. Mid-seventh week (15 mm.)

The lingual swellings grow rapidly and soon envelop the slowly growing tuberculum impar. This last structure is probably responsible for very little of the tongue surface, most of it being buried in the tongue. The body of the tongue is made up, therefore, by the fusion in the midline of the growing lingual swellings. The root of the tongue, as well as the valleculae and epiglottis, are probably derived from the copula and adjacent parts of the medial ends of the second, third and fourth branchial arches.[2]

The foramen caecum is not only a landmark, but represents the point of invagination of the thyroid anlage. In the three-week embryo this has begun to develop, and by five and a half weeks the bilobed mass of cells has completely separated from the epithelium of the tongue. This mass of cells is pulled, or grows down, into the neck, leaving in its path a tract of cells which forms the thyroglossal tract. Whether or not this tract is cannulated is the subject of much debate in the literature. The cells making up the tract are usually broken up into clumps of cells which, as a rule, become absorbed,

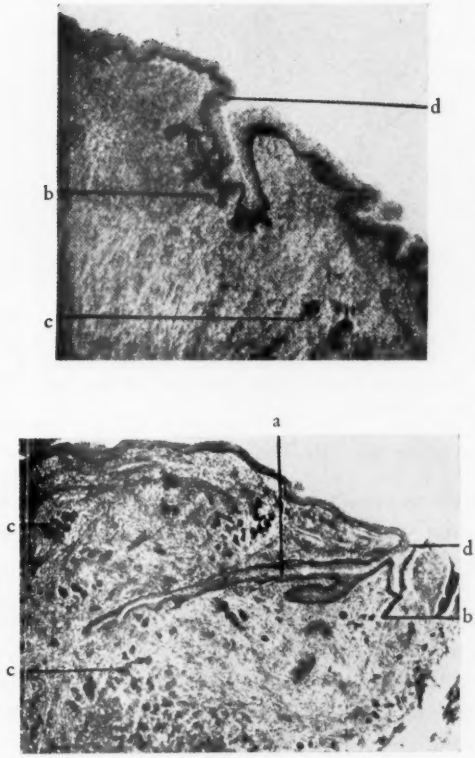

Fig. 2 and 3.—Photomicrographs of sagittal sections through foramen caecum in eight-week (Fig. 2) and five-month (Fig. 3) embryos. (From Wenglowski.[23])

a. Lingual duct.
b. Branching of lingual duct.
c. Mucous glands.
d. Foramen caecum.

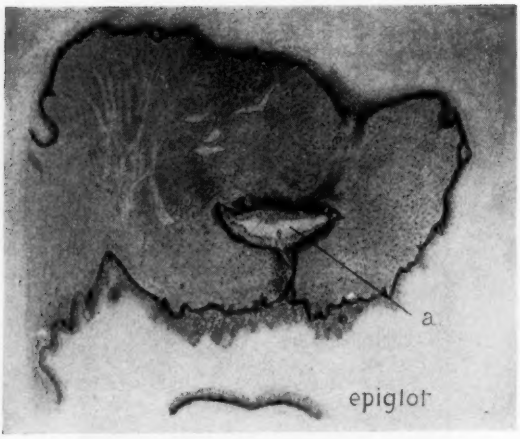

Fig. 4.—Photomicrograph showing secondary space (a) which forms at the root of the tongue during the third fetal month. (From Bertwistle and Fraser.[5]) (This space is very likely the same as that which Wenglowski termed the lingual duct.)

but may remain as rests.[2, 3, 5, 18, 22, 23] The pathway of the tract becomes interfered with by the developing hyoid bone, which pushes forward into the thyroglossal tract.

According to Wenglowski,[23] as the thyroid anlage breaks away from the epithelium of the base of the tongue, it pulls with it some cells of the epithelial covering of the tongue root, which is at this stage composed of mixed stratified squamous and ciliated columnar epithelium.

In the tongues of 18 out of 30 embryos, Wenglowski found that the foramen caecum entered a branching canal system, which he termed the lingual duct. This appeared earliest in the two-month embryos, in which it was short and unbranched. In later embryos, it was branched and lined with mixed squamous and ciliated columnar epithelium. He demonstrated six specimens with cystic formations in these branching ducts. Thyroid remnants were found in four specimens (Fig. 2 and 3).

Bertwistle and Fraser[5] described a similar structure at the base of the tongue. They found that during the third fetal month a space

is formed by the tissues of the tongue base overgrowing the region of the foramen caecum. This is described as a secondary cavity, lined by surface epithelium (Fig. 4).

During the fifth month, the base of the tongue becomes infiltrated with lymphoid elements, which grow gradually and form the so-called lingual tonsils.[2] Crypts and mucous glands develop during the last month of fetal life.

From the above discussion, one may postulate a large number of possible origins for these cysts.

1. *Thyroid*:

a. The epithelium pulled from the tongue surface by the descending thyroid anlage may remain as rests.[15, 23]

b. Small rests of thyroid tissue may remain undescended in the root of the tongue. Wenglowski[23] found 14 thyroid rests in 117 autopsy cases.

c. The thyroglossal tract itself, which many believe is a cannulated tube, may remain unabsorbed, as a potential cystic space.[3, 5, 12, 16]

Bailey[3] and many others[4, 7, 10, 12, 19] state that cysts of the thyroglossal tract may occur at the foramen caecum. He describes a case of an infant with a large cyst of the base of the tongue. He mentions two other very similar cases in infants who came to autopsy, having died as a result of asphyxia by cysts pressing on the larynx. Wardill[21] reported a case of a three-month-old female infant with a history of feeding difficulties and recurrent stridor. A mass could be palpated externally. At necropsy, with pressure on the mass, purulent contents could be expressed through the foramen caecum.

Both Bailey and Wardill based their diagnoses of thyroglossal duct cyst on the position of the cysts at the base of the tongue.

d. The entire thyroid may fail to descend and remain here as a lingual thyroid. Cystic changes may occur in the gland.

2. *Lingual Duct.* In 30 embryos, Wenglowski[23] found six with cysts of the tongue root. These cysts he attributed to changes occurring in one of the branching ducts. In autopsy specimens as well, the lingual duct system was found in 79 out of 117 cases. He

found that the epithelium lining the duct was stratified squamous close to the surface opening, while in the more distal branches it was frequently ciliated columnar.

He mentions finding cysts in the specimens, too, but does not mention the number. These cysts had thick connective tissue walls, infiltrated with lymphoid tissue, and a lining of mixed stratified squamous and ciliated columnar epithelium. Bertwistle and Fraser[5] described one case of a large cyst of the base of the tongue in an infant who died of asphyxia. This they attributed to cystic changes occurring in the secondary space which forms above the foramen caecum, during the third fetal month. Undoubtedly, this secondary space is the lingual duct.

Post[20] reported two similar cases in infants, both of which were diagnosed as congenital stridor. In one case the correct diagnosis was made by palpating the base of the tongue and prompt incision resulted in cure. The other case was diagnosed at autopsy.

In Leuw's case,[13] an infant who died of respiratory obstruction, the cyst was discovered at autopsy.

Both Post and Leuw mention the lingual duct as the probable origin. Many other writers[4, 7, 15] agree that this duct system, unmentioned by embryologists, is responsible for a large proportion of high suprahyoid cysts.

3. *Mucous Glands.* In three papers reporting cysts of the base of the tongue, their formation was ascribed to cystic changes occurring in mucous glands. Forsyth,[11] who described a case in a three-year-old child, makes this assumption based on the mucoid character of the contents of the cyst when it was incised. Whittier and Dombrowsky[24] reported a case in an eight-week-old infant who died of respiratory obstruction and pneumonia. At autopsy a large cyst was found at the base of the tongue (Fig. 5). They demonstrated the mucinous character of the contents by special stains, which was also taken up by the lining cells. It may be pointed out, however, that the goblet cells of respiratory epithelium also secrete mucin and will accept mucicarmine stain.

Lloyd[14] described a case in an emaciated four-month-old infant who died of asphyxia. At necropsy a large cyst of the base of the tongue was found. The cyst lining was stratified squamous epithelium. On the basis of this, the possibility of a thyroglossal origin

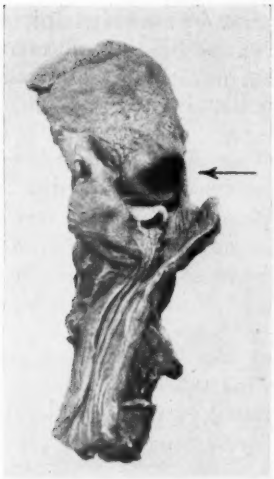

Fig. 5.—Cyst of the base of the tongue in specimen removed at autopsy (from Whittier and Dombrowsky[24]). Note how the epiglottis is tipped backward by the cyst pressing on its anterior surface.

was discounted. Inclusion dermoid was eliminated as a possibility because of its position. In consequence of this, and the fact that the contents were mucoid, a diagnosis of mucous cyst was made.

4. *Crypts of the Lingual Tonsil.* Recently we saw a middle-aged woman, who complained of a recent enlargement of one side of the base of her tongue. A mass was removed from the left side of the tongue base, which proved to be a cystic lingual tonsil. This, however, was a unilateral mass and the cyst in itself made up only a small part of it.

5. *Fetal Cell Remnants.* Duncan and Daniel[8] reported a case of a cyst in the tongue of a two-month-old infant. From their description and drawings, the cyst appeared to be more in the body than the base of the tongue. The histologic study of the cyst wall showed a lining of epithelium of a mixed type, with a wall composed of connective tissue, smooth muscle and glands resembling gastric mucosal glands. Their conclusion was that this cyst arose from a cell rest representing more than one germinal layer.

Nicholl and Teacher[17] reported a case of a huge cystic teratoma of the tongue of an infant. This was multiloculated and almost completely replaced the entire tongue. Histologically, there was no question of its teratomatous nature, and it was considered to be the unformed twin of the living child.

6. *Dermoid.* With the large number of fusion lines at the base of the tongue, one would presume that dermoid cysts would be more common. They must be, in fact, very rare at the base of the tongue, as I could find none reported. New[16] described a case of a dermoid cyst of the body of the tongue, opening onto the dorsum, in an adult male.

Colp,[7] in a report of a large series of cases of dermoid cysts of the mouth, mentions the tuberculum impar as a possible culprit in the formation of dermoid cysts in this locale. He does not, however, cite one example of a tongue root cyst.

Incidence. In most articles on congenital cysts of the neck, the writers mention the fact that cysts may occur at the base of the tongue, but after a careful study of the literature, only 12 actual cases were found, one of which was really a cyst of the body of the tongue.[8] All of these cysts occurred in infants or very young children. From this, it may be assumed that cysts of the base of the tongue are rare. That this is so is rather strange in view of the potentialities for cyst formation in this region. Indeed, perhaps they are more common than the number of reported cases would indicate.

Wenglowski found several cysts of the base of the tongue in 30 embryonic and 117 autopsy specimens. Presumably, then, more of these cases exist. It may be that no symptoms are produced until an upper respiratory infection with edema causes respiratory obstruction.

Symptoms. The symptoms usually date back to the very earliest infancy, and characteristically vary in the degree of severity from time to time. These infants have a peculiar cry, and inspiratory stridor. Intermittently they have attacks of complete respiratory obstruction with cyanosis. Death may occur in one of these attacks. Posturing of the patient may give partial relief from the respiratory difficulties. Regurgitation of feedings, dysphagia, and interference with the ability to suck, all contribute to inanition.

Diagnosis. In eight of the 12 reported cases, the diagnosis was made at postmortem examination. By direct laryngoscopy, how-

ever, the diagnosis should be simple. A carefully used tongue depressor or simple palpation may reveal the presence of the cyst. The importance of differentiating a cyst from a lingual thyroid must be stressed. This can usually be recognized by its solid appearance but, if necessary, a small incision will rule out a cyst. Similar symptoms may be caused by cysts of the larynx or pharynx, congenital stridor, laryngeal webs, or other congenital malformations of the upper respiratory passages.

Treatment. In three of the four cases in which the diagnosis was made in a living child, simple incision and drainage resulted in complete disappearance of the cyst. In the fourth case, which was really in the body of the tongue, complete excision, via the under surface of the tongue, resulted in cure.

REPORT OF A CASE

M. S., a wasted, dehydrated, white female infant of seven weeks was admitted to the Bronchologic Service at Jefferson Hospital, on December 16, 1948.

Since the age of two weeks, the baby had had increasing difficulty nursing and had regurgitated feedings repeatedly. Three or four times daily she would have sudden choking attacks with stridorous, difficult inspirations, and would become cyanotic.

On admission, the child was seen to have continuous stridorous inspirations, with indrawing of neck and chest. Intermittently, she would have prolonged periods of cessation of respirations and would become cyanotic. During these periods there were obvious unsuccessful attempts at inspiration. At first, all feedings were regurgitated. When placed on her side, the infant appeared to have less stridor and could take small, frequent feedings. General physical examination, aside from the above, was negative. Roentgen studies of the neck, chest and esophagus showed no abnormalities.

By direct laryngoscopy on December 22nd, there was found a rounded pearly gray mass anterior to the epiglottis, almost completely obscuring this structure, and lying between the epiglottis and the base of the tongue in the valleculae. A few distinct vessels could be seen coursing over the surface. It appeared quite firm to pressure, but because of the cystic appearance, incision was made and thick glairy material was evacuated. A segment of cyst wall was removed for histologic examination. Immediately following the incision, the

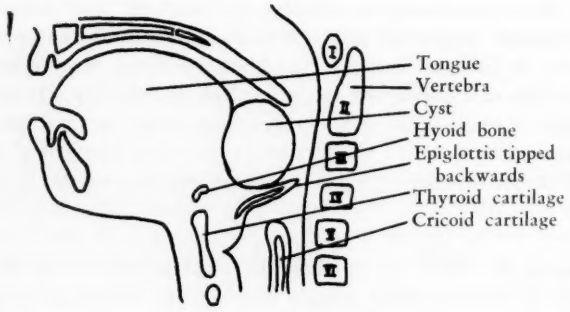

Fig. 6.—Schema of conditions existing in a case of a cyst of the base of the tongue.

cyst collapsed allowing the epiglottis to be seen without difficulty. The cyst appeared to be approximately 2 cm. in diameter in the coronal plane. The other diameters could not be satisfactorily determined, but following incision and collapse of the cyst, one could see the epiglottis, which in its vertical diameter was at least 1 cm., and which had been completely obscured by the cyst.

Immediately postoperatively, the patient was remarkably improved. There was a complete disappearance of all symptoms. In the next day or two the child developed a voracious appetite and, within the next week, had gained almost two pounds. There was no recurrence of symptoms.

On January 3, 1949, another direct laryngoscopy was done and, at this time, the larynx and the base of the tongue appeared normal. There was no evidence of refilling of the cyst (Fig. 6 and 7).

DISCUSSION

The large number of infant deaths reported as due to accidental mechanical suffocation, especially in children under one year of age, is appalling.[1] While many of these deaths must be due to bedding, bed clothes, or some similar object, causing occlusion of the air passages, it is quite likely that a considerable number of these cases may be due to unrecognized intrinsic abnormalities.[25] These abnormalities may very well include cases such as ours. The majority of the

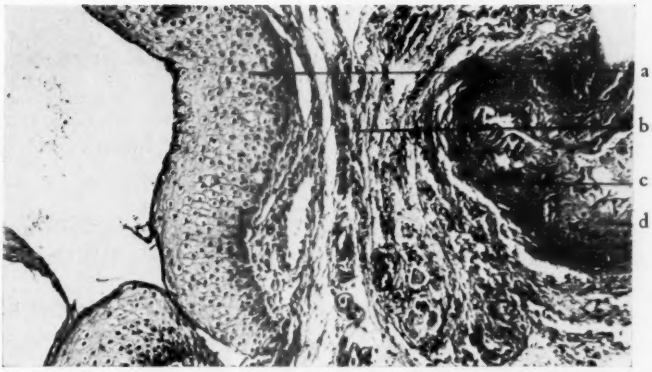

Fig. 7.—Photomicrograph of segment of cyst wall (x 100).
a. Surface epithelium of base of the tongue.
b. Underlying loose stroma.
c. Dense connective tissue cyst wall.
d. Stratified squamous epithelium lining cyst.

cases of cysts of the base of the tongue reported in the literature were diagnosed at necropsy in infants who died of "suffocation."

In all cases of these cysts reported in the literature they had similar histories, had almost identical gross appearances, showed similar histologic structure, and probably were similar in origin, even though the writers credited their origins differently.

Although the work of Wenglowski has been to a great degree disputed, his sections, showing the lingual duct at the base of the tongue, are difficult to explain away. Bertwistle and Fraser's secondary space at the base of the tongue is undoubtedly the same structure, and those authorities, who stated that the suprahyoid part of the thyroglossal tract is cannulated, may, in some instances, be describing the lingual duct.

The fact that the lining epithelium of these cysts may be stratified squamous or ciliated columnar, or a combination of the two, can readily be explained on the basis of the lingual duct cyst. It therefore seems most logical to conclude that the lingual duct is responsible for the formation of these cysts.

SUMMARY AND CONCLUSIONS

1. The embryology of the base of the tongue is reviewed. The lingual duct is described.

2. The possible origins are described. Case histories are taken from the literature.

3. These cysts, occurring only in infants, are rare, but may be more common than we are led to believe by the small number of reported cases.

4. Symptoms, diagnosis and treatment are reviewed.

5. A case is reported.

6. The similarity of histories, gross and microscopic appearances of the cysts in all the cases described leads one to the conclusion that they are all of the same derivation.

7. The lingual duct offers the most logical explanation for the occurrence of these cysts.

Cysts of the tongue base in infants constitute a medical entity which, although rare, should be considered in any case of stridorous respiration. Cystic changes in the lingual duct account for their appearance. Treatment by incision alone gives immediate relief, and may be sufficient for a permanent cure.

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Clinical Notes

XLIII

MACROGLOSSIA ACCOMPANYING PRIMARY SYSTEMIC AMYLOIDOSIS

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and

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The tongue is frequently involved in primary amyloidosis; of the 24 cases collected from the literature in 1938 by Koletsky and Stecher,[1] 18 showed an involvement of the tongue. In 1945, Lindsay and Knorp[2] collected 16 additional cases of primary amyloidosis and the tongue was involved in only one. In 1935, Balyeat[3] reported a case of macroglossia as the result of amyloidosis. Barnard and associates,[4] in 1938, reported two cases of primary amyloidosis and the tongue was affected in both. Baber[5] published a case of macroglossia accompanying primary amyloidosis in 1947. Of the 44 cases of primary amyloidosis reviewed, the tongue was involved in 24. In this same group, the heart was infiltrated with amyloid in 34 of the 44 cases. The extent of infiltration of the tongue with amyloid varied very widely in this series of cases. Red papules were present on the tongue in one case;[6] however, they were not suspected to be amyloid except in light of the subsequent clinical course. The tongue was red, thick and felt blistered in another case.[7] Sometimes the tongue was so large that the mouth could not be closed.[4] In a case reported by Barnard,[4] the tongue was found to be enlarged clinically, its movements were limited and the speech was muffled, although the patient did not complain about the tongue. In Binkley's case,[8] the tongue enlarged over a period of two years and yellowish nodules the size of a pea or larger appeared on the dorsum. Similar nodules were present on the inner surfaces of the lips. A biopsy specimen from the latter area stained with iodine and later with sulfuric acid and with methyl violet indicated that the homogeneous mass was mostly amyloid.

This case was studied while R. H. R. was associated with the University of Arkansas and F. E. N. with Trinity Hospital at Little Rock, Arkansas.

The most frequent specific symptoms given by these patients with amyloid infiltrating the tongue were swelling, dysphonia and dysphagia. Other symptoms usually were relative to the involvement of the cardiovascular and respiratory systems. Constipation, fatigue, edema of the extremities and pain in various portions of the body frequently were present. The swollen tongue most often was considered clinically to be the result of a neoplasm. In some cases it was thought to be the result of either myotonia or scleroderma. Rarely was the diagnosis of primary amyloidosis made clinically, although today it is recognized that one of the frequent findings in primary systemic amyloidosis is enlargement of the tongue. The macroglossia occasionally is accompanied by swelling of the neck and face due to amyloid infiltration of the skin, subcutaneous tissues or muscle.[1]

The clinical diagnosis of amyloidosis of the tongue is difficult to make; however, it should be considered always when there is a macroglossia. Histological examination of a biopsy specimen has not always proven satisfactory for the diagnosis. Recently Pearson and associates[6] suggested that the microscopic diagnosis could be made upon the finding of (a) the presence of numerous foreign body giant cells, (b) foci of lymphocytic infiltration and (c) the presence of amyloid rings.

Recently one of us (F. E. N.) admitted a white female to Trinity Hospital with a large, nonpainful tongue. She died suddenly four days later. Permission for only a restricted postmortem examination was granted. The correct diagnosis was made only after the microscopic sections were examined.* Since amyloidosis involving the tongue is infrequent, this case is reported only because of its rarity.

REPORT OF A CASE

J. C., a white female 67 years of age, was admitted with the chief complaint of difficulty in swallowing and breathing, loss of 30 lb. in weight during the past three months and generalized weakness. Seven months previously she first noticed a swelling of the neck "beneath the jaws." This was followed in one month by a thickening of the tongue and dryness of the mouth. These signs and

*This diagnosis was made by Doctor A. P. Stout.

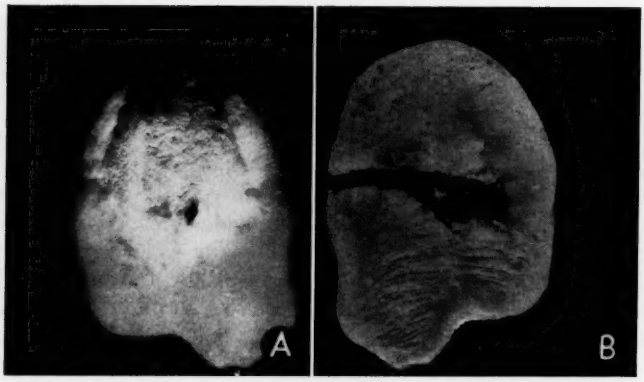

Fig. 1.—The tongue is enlarged. It is difficult to see the infiltration of amyloid in the gross specimen.

symptoms continued and progressed for six months when it became difficult to swallow and breathe. A foul yellow mucous material accumulated on the floor of the mouth. The patient stated that she found it most difficult to eat and there was no sense of proper taste. Pain had been present in the hands and wrists for the past two or three years.

Approximately two weeks preceding admission, she was given three roentgen ray treatments. The tongue felt normal the night following the first treatment; however, by morning it was as large as previously. A hysterectomy had been performed 25 years before. This had been followed by thrombophlebitis in the right leg and varicose ulcers which persisted until four years ago.

On examination the tongue was found to be approximately three times the normal size and to protrude from the mouth. When drawn into the oral cavity speech was almost impossible since the tongue completely filled the cavity. It was very hard, pale pinkish-gray in color, and the superior surface was covered by a thick yellowish-white fuzz. The floor of the mouth was normal. No saliva was present and none could be expressed from the submaxillary glands. The upper portion of the neck was symmetrically enlarged by indurated areas over both the submaxillary glands. No enlarged nodes were found in the posterior triangle of the neck. The systolic pressure was 145 mm. Hg. and the diastolic 90 mm. Hg. A harsh systolic

murmur was present at the apex and along the left sternal border. By percussion the heart was found to be slightly enlarged to the left.

The hemogram showed 4,140,000 red blood cells, 10,000 white blood cells with 78% polymorphonuclear leucocytes, 16% lymphocytes and 6% eosinophils. A specimen of urine removed by catheter was alkaline in reaction and it contained 2-3 red blood cells, 6-8 white blood cells per low power field, a rare hyaline cast and a 4+ albumin. The specific gravity was 1.020.

A tracheotomy was performed on the third day and approximately 36 hours later when she was lifted onto a bed pan she suddenly died. Both the heart beat and the respirations ceased at once; she did not change color or struggle. Clinically it was thought that the patient had a malignant neoplasm in the neck with involvement of the tongue either by tumor, or by a blockage of the lymphatics from the tongue.

Pathological Examination: The examination was restricted to the mouth and thorax. The tongue was very large, filling the entire oral cavity (Fig. 1). It was symmetrical and covered by a moderate amount of thick, yellow-like mucoid material. The entire specimen was removed. Along the cut margin there were focal irregular areas of grayish-white tissue which appeared to infiltrate the muscle. Further examination showed similar areas diffusely infiltrating the tongue. The grayish-white tissue stained more or less uniformly with eosin. Sometimes the muscle was completely replaced by the tissue and in other areas bands of striated muscle were widely separated by it (Fig. 2A). This infiltrating tissue stained a light blue with Mallory's connective tissue stain and reddish-purple with crystal violet stain. There was no cellular reaction in the tongue except for a few mononuclear cells near the covering epithelium.

The most interesting lesion was associated with the vascular system (Fig. 3). Essentially every artery had a thickened wall and in many instances the lumina were markedly decreased and frequently occluded. The walls of these vessels usually were composed of a hyaline-like material; however, in some of the vessels this material occurred only in focal areas. It stained blue with Mallory's connective tissue stain and reddish-purple with the crystal violet stain for amyloid. A proliferation of fibroblasts was present in the intima of some of the vessels.

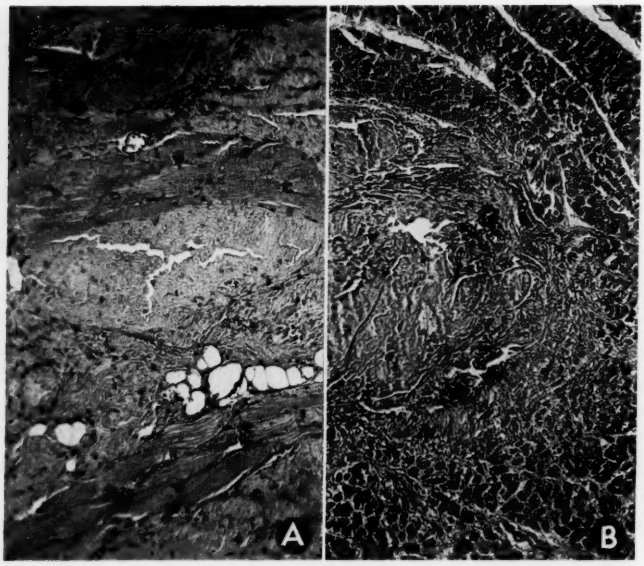

Fig. 2.—(*A*) Photomicrograph of the muscle in the tongue infiltrated with amyloid. The amyloid contains very few cells. (Hematoxylin and eosin stain.) (*B*) The cardiac muscle in a local area is replaced by amyloid. There is also some fibrosis in this area of amyloidosis. (Hematoxylin and eosin stain.)

There was a slight enlargement of both submaxillary glands. On the right the gland extended 2 cm. below the inferior border of the ramus of the mandible. The arteries in both glands were diffusely involved in a process similar to that of the vessels in the tongue. The vascular lesion was even more pronounced here than in the tongue. A few multinucleated cells were present in the wall of an occasional artery (Fig. 3A). There was no cellular inflammatory reaction in the submaxillary glands. The amyloid was restricted to the wall of the arteries in these glands.

The heart and lungs were examined in situ and a section was removed from the wall of the left ventricle. The lungs were grossly normal except for congestion of the posterior half. The heart was normal in size. Along the lateral portion of the left ventricle there was a moderate amount of fibrosis. This change extended deep into the myocardium. Microscopically the muscle was infiltrated with

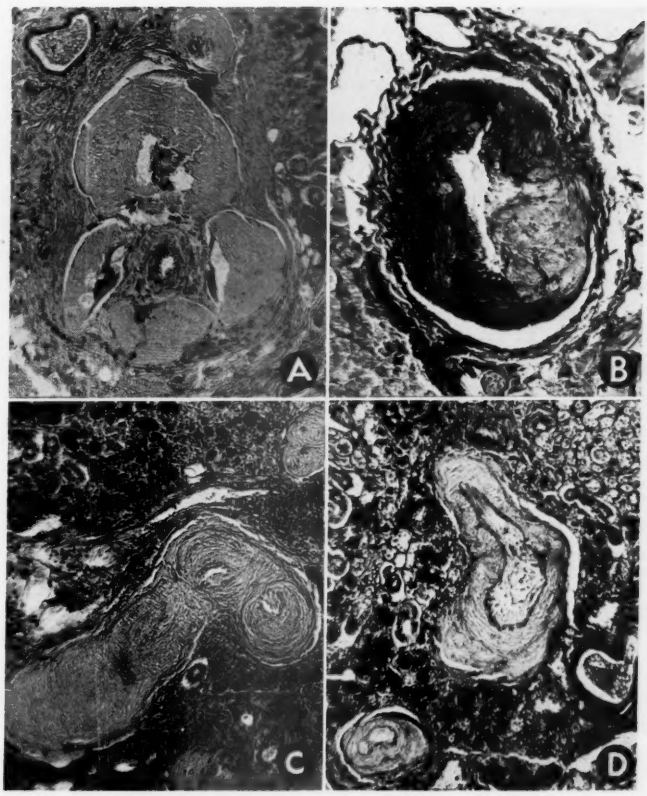

Fig. 3.—Photomicrographs showing the vascular lesion which is one of the most conspicuous changes found in this case. (*A*) Large area of amyloid about small arteries in the submaxillary gland. Note the giant cells. (Hematoxylin and eosin stain.) (*B*) A small portion of the vessel is infiltrated with amyloid. (Verhoeff-van Gieson stain.) (*C*) The vessel wall is diffusely infiltrated with amyloid. The lumen is essentially occluded. (Hematoxylin and eosin stain.) (*D*) The lumen of some of the arteries are decreased by a proliferation of connective tissue from the intima. (Verhoeff-van Gieson stain.)

amyloid (Fig. 2B). The arteries were involved similarly to those in the tongue and submaxillary gland.

DISCUSSION

The pathological changes in this case are similar to those frequently described in the literature.[1, 2, 6, 7] The prevailing concepts as to the etiology and pathogenesis of primary amyloidosis are reviewed by Koletsky and Stecher.[1] Amyloidosis is usually classified as (a) primary, (b) secondary, (c) tumor forming, and (d) associated with multiple myeloma.[7] Tissues of mesenchymal origin are primarily involved in "primary systemic amyloidosis," while in "secondary amyloidosis" the parenchymatous tissues are infiltrated.[6] Macroglossia may accompany amyloidosis of the bone marrow[9] and cases associated with multiple myeloma.[10] Spain and Barnett[11] reported a case of secondary amyloidosis in which the tongue was involved. The tongue was bright red and glossy but no sections were made in a case of primary amyloidosis reported by Golden.[12]

A correct clinical diagnosis of primary amyloidosis was made in only nine[1, 3, 6, 7, 9, 13, 14, 15, 16] of the 44 cases reported. Of these nine cases, macroglossia was present in six.[3, 7, 13, 14, 15, 16] A histological study of a biopsy specimen was the basis of the clinical diagnosis of some of these.[7,13] Although Pearson and associates[6] considered certain histologic criteria as diagnostic, a review of the reported cases and a study of our case could indicate the absence of any constant microscopic characteristics. It appears that the clinical diagnosis of amyloid disease of the tongue more likely may be made at this time, either through experience or by recalling the fact that macroglossia frequently results from amyloidosis. The clinical diagnosis of primary amyloidosis in the absence of macroglossia may be difficult. Detailed clinical and laboratory studies have been made in cases of primary amyloidosis without contributing much to methods of diagnosis except for the use of the Congo red dye.[17, 18]

Vascular and myocardial involvement frequently occur in primary amyloidosis.[19-21] Death may result from myocardial failure.[19] It is likely that death in our case resulted from either a pulmonary embolus or vascular involvement of branches of the coronary arteries. It is too bad that a complete examination was not made in view of the rarity of primary amyloidosis. However, at the time of the autopsy, we considered the lesion only as a sarcoma of the tongue and myocardial fibrosis.

SUMMARY

The tongue was involved in 24 of the 44 cases of primary amyloidosis collected from the literature. The clinical diagnosis of primary amyloidosis is difficult to establish; however, a biopsy and the Congo red stain may be helpful. The demonstration of amyloid by staining techniques apparently is preferable to only histologic characteristics for the diagnosis. Since macroglossia frequently accompanies generalized amyloidosis, this pathologic syndrome always should be considered when the tongue is enlarged.

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XLIV

FATAL AIR EMBOLISM DURING ANTRAL IRRIGATION

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AND

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Lavage of the maxillary antrum is a commonplace office procedure in the diagnosis and treatment of maxillary sinus disease. Its technique, which has been used for decades, is relatively simple and requires but few precautions (which are not usually taken) and reasonable care (which is not generally used) to avert undesirable consequences.

Complications, however, are not uncommon and even fatalities may occur. For example, dehiscences may exist in the osseous walls of the antrum; in such instances, irrigation of the sinus, whether by puncture of the inferior meatus or by the natural ostium, may give rise to infiltration of the tissues of the cheek, eyelids, orbit, pharynx or nasopharynx with air or irrigating solutions, or, infected material from the sinus may be extruded into the tissues causing local infections, such as facial cellulitis, and abscesses of the orbit and peri-orbital tissues. These same complications may also occur, in the absence of osseous defects, with faulty placement of the irrigating cannula. Such cases have been reported following irrigation of the sinus through both the middle and inferior meatuses.[1]

Injury to the nasolacrimal duct may also be incurred. In one of our cases of antral lavage, in which the sinus was entered by puncture of the inferior meatus, a thin jet of irrigating solution spurted from the lacrimal duct. Examination of the patient at a later date revealed no demonstrable damage, however.

Temporary blindness of the right eye, due to occlusion of the central artery of the retina, was reported by Hirsch.[2] This occurred

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following air insufflation of the right antrum, entered by the natural ostium. Immediate examination revealed air bubbles in the retinal arteries.

In a fatal case reported by Pordes,[3] a 51-year-old female patient had her antrum washed for a purulent sinus infection. The first attempt to enter the antrum was unsuccessful, but on the second try, free pus came through the cannula in the lavage. Four days later a swelling developed on the face with temperature and edema around the eye, and notwithstanding two subsequent operations the patient died six days later.

The autopsy revealed a meningitis and showed that the needle had, on the first try, gone through the tuber maxillare into the soft tissues of the pterygopalatine fossa from where the fatal infection ascended.

An infrequent but grave accident which may complicate the antral lavage is air embolism. Boenninghaus[4] has reported 11 fatal cases in seven of which autopsies were performed. He claims that the air reaches the right heart through the facial vein by the internal jugular vein, but that it may also cause death by hitting the breathing center in the medulla oblongata where it is very difficult to determine by autopsy.

Grove,[1] in an extensive review, cites 15 fatalities during lavage of the antrum; two of the seven cases in which autopsy was performed showed air emboli in the pulmonary circulation, while the remaining five cases were reported as "negative." Goldenburg[5] mentions one case of antral lavage which resulted in death following the use of air. Autopsy revealed air in the heart and in the cerebral, coronary, and mesenteric arteries. Another example of air embolism, corroborated by postmortem examination, is reported by Bacher.[6]

McGovern[7] also describes a case of collapse and death in a patient following the introduction of air in the course of puncture and irrigation of the antrum; autopsy, however, was not performed. He reports, too, the occurrence of generalized convulsions, coma and paresis of one extremity (with subsequent recovery) after the use of air in an antral lavage irrigated through the natural ostium. It is his belief that air embolism was responsible for the severe reactions in both cases since they occurred after the injection of air and withdrawal of the cannulae.

Bashir, Taneja and Shah[8] describe a similar case of collapse and paralysis during irrigation with subsequent complete recovery. There are, of course, other cases which have been reported; however, it must be pointed out that there are probably many more which never reach publication.

The case described in the following report is another example of fatal air embolism complicating irrigation of the maxillary sinus.

REPORT OF A CASE

The patient, a white male aged 46, presented himself at the Ear, Nose and Throat Clinic of the Post-Graduate Hospital complaining of nasal obstruction and a cough of two weeks' duration which had become productive of brownish-yellow sputum. There was no history of chills, fever, or loss of weight. Symptoms referable to the respiratory, cardiovascular, gastro-intestinal, and neuromuscular systems were absent, but the patient admitted being very nervous and irritable. His past history was uneventful except for a nasal fracture at the age of 13, and correction of the nasal deformity three or four years before the present illness.

Examination revealed the nose to be slightly deviated to the left, and scant mucoid discharge in both nasal fossae. There was an acute inflammation of the larynx, involving the arytenoids and vocal cords. Heart and lungs were clinically normal; blood pressure was 130/90. Laboratory studies (urine, complete blood count and sedimentation rate) were within normal limits; the Wassermann test was negative; and the sputum was negative for tubercle bacilli.

Roentgenograms of the chest showed a small aortic type of heart with a moderate degree of bronchial thickening extending into both lower cornua; the peripheral lung fields were clear. Since roentgenographic study of the sinuses showed clouding of the right antrum and to a lesser extent of the right ethmoid cells, diagnostic lavage of the maxillary sinus was decided upon.

Anesthesia was effected by packing the right middle and inferior meatuses with small pledgets of cotton moistened with a 2% solution of cocaine with 1/3 of 1% phenol in saline.

Following a preliminary washing of the nasal cavities, a blunt-tipped catheter was introduced with ease into what was thought to be the natural ostium, but removed in order to quiet the patient who

had become quite nervous and unco-operative. Subsequently, the antrum was entered with a Douglas cannula by puncture through the inferior meatus and irrigation of the sinus was begun with sterile saline solution. The return flow of fluid from the sinus was slower than usual, but the irrigation was continued since the patient made no complaints. He was still extremely nervous, but co-operative and responsive to questioning. The first few drams of fluid were tinged with blood and contained a few mucopurulent shreds; when the washings became clear and remained so, air was introduced into the sinus without incident until the irrigation was about to be discontinued. At this point, the patient complained of "feeling funny," became rigid, was seized with a generalized convulsion, fell to the floor and ceased breathing.

Artificial respiration was begun immediately and 1 cc. of coramine was injected into the heart. Oxygen was administered by pressure mask, and adrenalin and coramine given intravenously, but to no avail. The patient was pronounced dead and the body removed to the city mortuary with the presumptive diagnosis of death by air embolism.

Postmortem examination was performed by the Medical Examiner's Office approximately six hours after death. The heart and inferior vena cava were markedly distended and the release of air was loudly audible upon incision into the heart. Exploration of the right maxillary sinus showed a recent opening in the medial wall; the natural ostium was not identified. The mucous membrane was very hemorrhagic and slightly thickened. There was no evidence of trauma to the walls of the sinus other than at the site of puncture. No air was discernable in the cerebral vessels. The remaining organs of the body were found to be congested.

The cause of death was reported as massive pulmonary air embolism.

COMMENT

It is generally accepted that air may enter the circulation, following insufflation after lavage, through the veins of the antral mucosa. The rapidity of death would seem to indicate that embolus either hits the right heart, a large coronary, or the breathing center of the central nervous system. While it is conceivable that this would happen more often in cases in which the puncture was made through the inferior meatus, it is noteworthy that similar accidents have oc-

curred when the irrigation was performed through the middle meatus or natural opening.

Thickened mucous membranes and increased vascularity, which are present in sinus diseases, facilitate the possibility of these accidents. Precautions are therefore necessary.

This brings up the question of the necessity of blowing air into the sinuses after lavage. The authors are of the opinion that if the lavage is performed correctly there is no necessity to follow it up with air. Emphasis, however, must be placed on correct technique. When, after local anesthesia, the needle is inserted under the inferior turbinate, the middle meatus, or into the natural opening, it should be easily movable and the end should be free. There should be no pain or resistance while putting in the water. The surest way to determine whether or not the needle is in the right position would be to use a small syringe first to withdraw air, pus, or pussy mucoid discharge from the sinus. Only after this is done should an injection of water follow. If there is any difficulty in withdrawing the syringe, or if blood follows the withdrawal, one should refrain from putting anything further into the sinus.

CONCLUSIONS

1. Antral irrigation is a relatively safe procedure, but subject to accidents of varying severity.

2. An infrequent but grave complication is air embolism.

3. A case of fatal air embolism is presented.

4. Inflation of air following an antrum lavage is unnecessary if the lavage is performed correctly, and should be avoided.

124 EAST 84TH STEET.

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XLV

MIXED TUMOR OF INFERIOR TURBINATE

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Primary tumors of the inferior turbinate are extremely rare, there being very few references in the literature on this subject. The case which I am about to report was interesting, not so much from the clinical angle as from the point of view of the histopathology.

A young, white, married woman in her early thirties, presented herself with a history of repeated severe nasal hemorrhages from the left side which had been occurring spontaneously at irregular intervals for several months with increasing severity. Unilateral nasal obstruction was noted during the free intervals. There were no other untoward symptoms. The family history was negative and the patient, the mother of one child aged 10, had always enjoyed good health.

Examination revealed an extremely friable mass on the left side just beyond the vestibule, seeming to arise from the lateral wall of the nasal cavity in the region of the inferior turbinate and extending to the floor of the nose. Because of its tendency to bleed at the slightest touch, it was impossible to determine the extent of the growth. However, it was not visible by posterior rhinoscopy. A specimen was taken for biopsy and reported "granulation tissue."

Since the patient's septum was deviated to the left it was decided to do a submucous resection, thus affording more room for removal of the growth. Prior to the operation an examination of the blood revealed all elements within normal limits.

After the submucous resection the growth was removed piecemeal and found to involve the greater part of the inferior turbinate almost to its posterior end. It was extremely friable and hemorrhagic and extended over both surfaces of the turbinal. Some hyperplastic mucosa was at the same time removed from the posterior end of the turbinate. The bone did not appear to be involved.

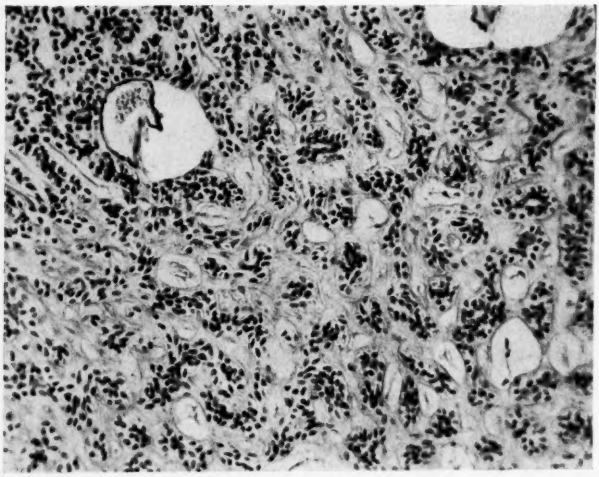

Fig. 1.—Photomicrograph of section of mixed tumor of inferior turbinate.

The first report from the pathologist was "adamantinoma." This diagnosis was later rejected in view of the fact that nowhere was there any indication of any connection with a tooth germ. A slide was sent to the Army Institute of Pathology and the following report returned:

"It is the feeling of the staff members that this lesion should be classified as a form of mixed tumor. It demonstrates the pattern usually seen in those mixed tumors occurring from the palatal glands. This group is a bit different from the standpoint of behavior than those affecting the major salivary glands, for which reason considerable speculation has arisen as to their correct terminology. Thoma used the term "Adenocarcinoma," although he freely admits that they do not regularly metastasize. They are, however, locally invasive.

"It does not seem likely that the concept of Willis, who suggests that these paranasal tumors might possibly be associated with the ameloblastoma, is well taken. The possibility of epithelial rests of Hertwig's sheath migrating as far away from the periodontal space as would be necessary if such were the case, is highly unlikely. The

morphology of the epithelial cells is considerably different than seen in the usual ameloblastoma. The cystic features suggestive of the stellate reticulum of the tooth bud are absent. In addition, the peripheral cells do not show the tendency to palisade seen in the odontogenic tumor. We are coding the case, therefore, as a mixed tumor of the nasal chamber."*

One finds in the literature some difference of opinion as to histogenesis and terminology in tumors of this type. The term "amyloblastoma" is frequently used to denote the type commonly accepted as "adamantinoma." Ringertz,[1] on the other hand, believes these tumors have a common origin with salivary growths and develop from misplaced cells of the original anlage.

In the case above described, it is difficult to assign it to any well defined category. One can only say that it represents an atypical hyperplasia bearing some resemblance to "ameloblastoma," "salivary gland tumor" and "adamantinoma" and yet failing wholly to conform to the standard pictures of these entities as recognized in the past. The analysis furnished by the Army Institute of Pathology cited above summarized the situation as clearly as our present state of knowledge permits. One must, therefore, accept the diagnosis as a "mixed tumor."

Whether the growth will recur is still a matter of conjecture since only a few months have elapsed following surgery. At the present time the turbinate is healed and completely covered with what appears to be a normal mucosa.

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*Courtesy Raymond O. Dart, Brigadier-General, U.S.A., Director.

XLVI

MIXED TUMOR OF NOSE TREATED BY RHINOPLASTIC PROCEDURE

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In the following, a case of mixed tumor of the interior of the nose, removed and apparently cured by endonasal rhinoplastic procedure, is reported. Because this management is unique and also on account of the varied pathologic opinions submitted, its recording would seem noteworthy.

REPORT OF A CASE

Mrs. M. B., aged 56, was referred to me on August 31, 1944, because of a growth in the left side of her nose. The patient had first noticed this two months previously. The breathing was by now moderately obstructed on that side. Bleeding had occurred on a few occasions. There had been no headache, and no history of previous attacks of sinusitis.

Examination revealed a purplish, polypoid mass partially filling the left nasal cavity. Manipulation of the mass resulted in bleeding. It appeared to have a sessile attachment to the roof of the nose. The frontal and maxillary sinuses transilluminated moderately and about equally. X-ray films of the sinuses reported by Dr. F. A. Stephenson showed "the frontal to be negative; some clouding of the middle and posterior ethmoid cells, probably with thickened membrane. Both antra were cloudy; the right was rather homogeneously dense and probably retained some inflammatory products; the left showed thickened membrane with some air content. The sphenoids were negative. There was no visible bone involvement. The possibility of malignant involvement in the left ethmoid and antrum was not excluded, but the appearance was more that of chronic infection."

The greater portion of the tumor mass was removed with a nasal snare and submitted for pathologic examination. The report by Dr. S. Kurland on September 1, 1944, was as follows: "The specimen consists of grey, white, focally hemorrhagic, friable fragments of

tissue removed from the nose. These fragments measure up to 1 cm. in greatest dimensions.

"Microscopic examination reveals the specimen to consist of a basophilic matrix in which are embedded atypical and anaplastic cells, of a rather bizarre nature. Most of the cells are small and of uniform appearance. However, some of these cells are very large with giant proportions. Other portions distinctly resemble cartilage. One surface of the tissue is covered by a stratified squamous epithelium. In many areas are accumulations of small round cells.

"Diagnosis: Chondromyxosarcoma of the nose."

Confronted with an intranasal neoplasm as highly malignant as chondromyxosarcoma, the method of choice for its eradication appeared to be radical removal, including loss of the external nose. The patient refused such treatment. It then occurred to me that a rhinoplastic procedure for removal of the nasal hump, which was rather prominent in this patient, might succeed in totally extirpating the tumor. The origin of the growth appeared to be from the cartilaginous nasal vault close to its attachment to the nasal bones.

The patient readily consented to this type of operation, which I performed on September 20, 1944. The hump was removed endonasally with Joseph saws through the usual intercartilaginous incisions employed in rhinoplasty. The resulting wide nasal arch was narrowed and re-established by typical lateral osteotomies. Inspection of the undersurface of the removed hump showed the origin of the tumor to be from the cartilaginous vault where the septal and left upper lateral cartilages joined.

The pathologic report on the specimen removed at operation was made by Dr. Charles B. Kingry, as follows: "The specimen consists of a portion of the bridge of the nose and cartilaginous portion of the septum measuring about 1 x 1 x 3 cm. The specimen is divided into parts, the smaller mass being soft and spongy at one end and cartilaginous throughout the remainder. Sections show a central longitudinal strip of cartilage bounded on one side by mucous membrane covered with columnar ciliated epithelium, at one end of which there is a marked proliferation of varying size, large, hyperchromatic cells in a very vascular loose fibrous matrix. In many areas of the matrix is rather dense, hyaline fibrillar tissue infiltrated with small round polyhedral cells. The tumor cells are in some instances very similar to cartilage cells and in one area the tumor pro-

Fig. 1.—Before and after photographs of patient with mixed tumor springing from inner surface of roof of nose, removed by rhinoplastic procedure.

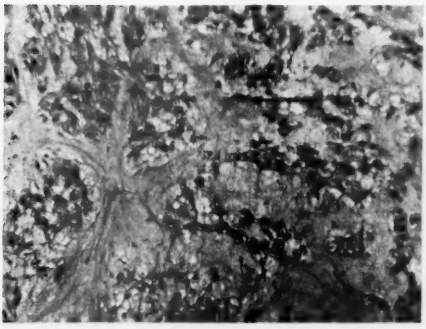

Fig. 2.—Section through neoplasm showing mixed tumor formation. See description in text.

liferation appears to spring very definitely from the cartilaginous plate.

"Diagnosis: Chondrosarcoma of the nose."

Because of the highly malignant character of chondrosarcoma, a diagnosis concurred in by two pathologists, 50 mg. of radium were placed high in the left side of the nose for 18 hours on November 8, 1944, affording 900 mg. hours of irradiation.

The patient has been carefully watched for local and regional metastases. To date, almost five years since the tumor was removed, there has been no sign of recurrence. Figure 1 shows the patient's photographs before and after the hump and tumor were removed.

Recently, when the slides made from the specimen removed at operation were reviewed by Dr. E. I. Dobos, at present pathologist at the hospital, he was unable to substantiate the diagnosis of chondrosarcoma previously made. The slides of the original biopsy specimen also, in his opinion, did not show this type of tumor. Furthermore, the pathologist who had submitted the original diagnosis of chondromyxosarcoma was now also unwilling to re-affirm his original diagnosis. Three other pathologists have since reviewed the slides and have agreed that the specimen belongs to the "mixed tumor" category.

It is well known that mixed tumors are sometimes found in the pharynx and nasopharynx. Their presence in the nasal cavity proper appears to be unusual. Figure 2 shows microscopic specimens ex-

hibiting mixed tumor formation. The supplementary description of the specimen by Dr. S. K. Kurland follows: "Microscopic examination reveals the specimen to consist of isolated groups of rather uniform small pyramidal to oval cells with indistinct cell boundaries and small to moderate amounts of acidophilic cytoplasm. Occasionally the cells are of giant proportions and contain rather large bizarre hyperchromatic nuclei. At times the cells are embedded in a rather loose fibrillar basophilic matrix. The tissue is covered on one aspect by stratified squamous epithelium.

"Diagnosis: Mixed tumor, nasal cavity."

It is interesting to speculate what management I would have adopted if the growth had originally been designated as mixed tumor. After thoroughly eradicating the tumor intranasally I could have supplemented this with surgical diathermy. This would follow the usual treatment accorded mixed tumors. Considering the bleeding, rapid growth and inaccessability of the neoplasm I might have regarded intranasal management inadequate and could have chosen the rhinoplastic procedure as one more certain of total eradication. Under the circumstances this choice was certainly a happy one for the patient, having spared her a needless, disfiguring deformity.

The other aspect of this case worthy of comment is that two qualified pathologists presumably without knowledge of the other's opinion, originally rendered almost identical histologic diagnoses. Later they were proven in error by re-examination of the slides, both by themselves and three other pathologists.

Not in a spirit of censure, but rather to stress a point which clinicians sooner or later must realize, one may be pardoned this truism: Pathology, one of the most highly developed of the medical specialties, is like other branches of the medical art, far from being an exact science.

CONCLUSIONS

An intranasal tumor, springing from the bridge of the nose and originally reported as chondromyxosarcoma, was treated by rhinoplastic procedure involving removal of the nasal hump. This was supplemented by 900 mg. hours of radium.

To date, almost five years later, there have been no signs of recurrence or metastasis.

Present pathologic opinion declares the growth to have been mixed tumor.

Use of the rhinoplastic procedure was fortunate and adequate in this patient and is a method worth considering in cases of similar nature.

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XLVII

NEURINOMA OF THE TONGUE

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Many opinions have been given of the origin of neurinoma which was first described by José Verocay in 1908. In these days, however, it is generally recognized as a tumor formed by the elements of the schwannian syncitium (the delicate protoplasmic envelope enclosing fibers).

Lingual new growths of nervous origin have been reported by Babrow, Abbot and Schattock, Malan, Krumbein, M. Borchardt, A. Hayashi, Berggren, Tempel, Froboese, Terplan, Radofsky, K. Maruyama, K. Okida, M. Yokoi, and T. Rokushima; but among these cases reports of "neurinoma" were very few.

The present case of macroglossia has been shown to be histologically a typical neurinoma according to Verocay's description. It was made up of characteristic whorls and groups of elongated cells arranged in a laminated fashion, with their nuclei lined up to form palisades or ranks which produce lines across the microscopic field.

REPORT OF A CASE

History: H. I., a schoolboy aged 16 years, was admitted to the hospital on August 20, 1948, with a complaint of macroglossia and disturbed articulation of speech. He dated the onset of swelling of the tongue from his infancy. The tongue enlarged over the years, but it never caused disturbances or pain on swallowing. The past and family histories were irrelevant.

Examination: The anterior two-thirds of the tongue, particularly the left side, was greatly enlarged and showed a typical macroglossia filling the oral cavity. Palpation revealed an egg-sized, ovoid, noncystic, elastic and soft tumor in the body of the tongue. The shape and size of this tumor were much better defined when the

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Fig. 1.—Macroglossia.

Fig. 2.—Macroglossia.

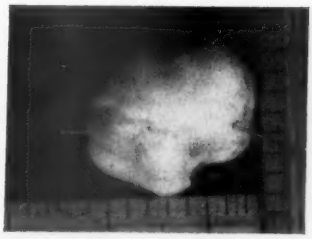

Fig. 3.—External appearance of the tumor showing its smooth capsule.

Fig. 4.—Photomicrograph demonstrating typical morphology of neurinoma.

tongue was protruded. The overlying mucous membrane was intact. His articulation of speech was markedly impaired.

Operation: Under local anesthesia, the whole tumor was easily removed without any bleeding.

Pathologic Examination—Gross: The specimen was a smooth encapsulated mass, weighing 11.8 gm. and measuring 4 x 2 x 3 cm. On section it was milky white in color and with moderate stroma.

Microscopic: The histological examination showed a typical neurinoma with many bundles and whorls, or garlands of elongated cells. Characteristic were the ranks or palisading of the nuclei which occurred in numerous foci forming the typical Verocay body of a neurinoma.

SUMMARY

A rare case of solitary neurinoma of the tongue is reported.

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XLVIII

NEURINOMA OF THE ETHMOIDAL SINUSES

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SAINT LOUIS, MO.

Neurinoma, a tumor originating from the cells of the sheath of Schwann of peripheral nerves, has been extensively reported in almost all regions of the body. However, this type of tumor occurs rarely within the nasal cavities and the nasal sinuses, so that it is of interest to report a case of this kind.

Neurinoma is also called neurofibroma, neurolemmoma and schwannoma. Neurinoma occurs as a solitary tumor, and also in the form of multiple tumors, as a part of von Recklinghausen's disease.

Ten cases of neurinoma occurring in the nasal fossae and nasal sinuses were found to have been reported in the literature. Terplan and Rudofsky[13] reported a neurinoma involving the left nasal cavity and ethmoidal sinuses in a 13-year-old girl, with symptoms of seven weeks' duration. Considerable bleeding occurred when the tumor was removed. This patient was well at the time of the report, 16 months after operation.

Stout[11] reported an interesting case in a female, aged 60, who had four subcutaneous neurinomas on the extremities, of many years' duration. In later years she developed a tumor in the nasal cavity, which proved to be a sarcoma. This nasal tumor recurred four years after removal, and at that time, sections of tissue removed at operation showed characteristic nerve sheath tumors, in addition to the recurrent sarcoma. This woman did not show any other manifestations of von Recklinghausen's disease aside from the neurofibromas on the extremities, and it is of interest to note that this is the only one of the cases in which there were multiple growths of this type.

Mittelbach and Woletz,[8] in 1935, reported two instances of this type of growth. The first was in a 25-year-old man, in whom the left nasal fossa and left maxillary and ethmoidal sinuses were filled

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with tumor tissue. There was destruction of the lateral nasal wall, lateral wall of the maxillary sinus, and, in addition, the neoplasm had invaded the orbital cavity. The tumor was very vascular and bled profusely at the time of operation. These authors' second case occurred in a 17-year-old boy. The right nasal fossa was filled with tumor tissue, which bled profusely at operation.

Bogdasarian and Stout,[1] in 1943, reported a neurinoma occurring in the left nasal fossa, attached to the nasal septum, with unilateral nasal obstruction of two years' duration. Bleeding was not a problem in their patient and they were able to excise the growth by means of a snare, through the nostril.

New and Devine[10] reported three cases. Two of these were in the nasal fossae and one involved the sphenoidal and maxillary sinuses and the nasopharynx. In only one of these patients was bleeding a prominent symptom.

Eggston and Wolff[2] recorded two cases: one in a female aged 28, and one in a male aged 46. In both, the neurinomas involved the ethmoidal and frontal sinuses and had invaded the orbits. In both instances the growths could not be completely removed because of their position and did not respond to irradiation. In a 14-year period, 1931 to 1944, at the Manhattan Eye, Ear and Throat Infirmary, Eggston and Wolff reported only three neurofibromas of the nose and nasal sinuses out of 359 neoplasms of the nose and sinuses.

In addition to the foregoing cases, Weinhold, in 1810, and Cruveilhier, in 1864, are credited with early reports of cases of neurinomas arising in the nasal cavities and the maxillary sinuses. Both authors' cases are cited by Virchow,[14] Bogdasarian and Stout,[1] and Stout[11] as probable examples. No microscopic sections were presented or described for these early cases.

At the Johns Hopkins Hospital, Geschickter[4] reported on 211 tumors selected from 2000 specimens removed surgically in the Department of Laryngology and Otology. No neurinomas were described.

At the Saint Louis University School of Medicine, no previous cases of neurinoma occurring in the nose or nasal sinuses have been found. This takes into consideration the statistics at Saint Mary's Hospital for the past ten years, during which time 66 new growths have been found in the nose and nasal sinuses (13 from the sinuses

and 53 from the nasal fossae), and the statistics at the Firmin Desloge Hospital in a 16-year period, 1933 to 1949, during which time 35 neoplasms were found (13 from the nasal sinuses and 22 from the nasal cavities). Nasal polypi were not included in these statistics.

Stout,[11] in 1935, published a thorough study of neurinoma occurring in the peripheral nerves. He excluded from his study all other tumor types associated with peripheral nerves and their sheaths, such as pure fibromas, neurofibromas of von Recklinghausen's disease, and the various malignant tumors. On this basis he reported on 52 cases of his own and 194 cases from the literature. The distribution of these lesions is of interest. He found the usual sites to be the anterior or volar aspect of the upper extremity and the posterior aspect of the lower extremity. These lesions tended to occur more frequently near the flexion creases of the extremities. The lesions occurred fairly often in the neck, scalp and face. However, they were relatively infrequent on the trunk, in contrast to the distribution in von Recklinghausen's disease where the trunk is a common site for the characteristic skin nodules. Several instances were reported of this type of tumor in the orbit, tongue and hard palate. Stout found a few cases in the larynx, and one instance in the retropharynx and one in the retrotonsillar area.

Ewing[3] states that neurinomas occur in all parts of the body, in the subcutaneous and intramuscular tissues of the limbs, neck, orbit, tongue, larynx, mediastinum, peritoneum, spinal cord and stomach.

Credit is given to Verocay[15] for the first histological description of neurinoma in 1908. Verocay originated the term "neurinoma" in 1910. Antoni[16] in 1920 distinguished the two types of tissue comprising these tumors and named them types A and B. Later writers on this subject (Ewing,[3] Moore,[9] MacCallum,[6] Eggston and Wolff[2]) recognize this division and complete description of the histology of these tumors appears in numerous texts on tumor pathology. Type A tissue presents a rather orderly pattern of long slender fibers and cells having elongated nuclei, with a tendency for the nuclei of several adjacent cells to lie parallel, an arrangement which is called palisading. Type B tissue shows no orientation of fibers and cells, or any attempt at differentiation of tissue. The cells and fibers lie in a haphazard manner. The entire tissue is loose-textured, due, in part, to intercellular fluid which separates cells and fibers, and, in part, to collection of fluid degeneration products into micro-

scopic cystic spaces. A neurinoma is made up of both types A and B tissue in varying amounts. According to Stout,[11] blood vessels are usually quite numerous but tend to be unequally distributed. These vessels are capillaries, and not infrequently are widely dilated and sometimes occluded by thrombi. Hemorrhage is frequent and old blood pigment may be found in the tissue.

Neurinomas are generally considered to arise from cells of the sheath of Schwann of peripheral nerves. However, this origin of these tumors has been disputed. Krumbein[5] stated that palisading of nuclei is not characteristic but is also found in myomas and sarcomas. Krumbein did not think that neurinomas arose from Schwann's sheath cells, but from endoneurium and from connective tissue. On the other hand, Masson[7] presented experimental work and observations to show that these tumors did originate from Schwann cells. A discussion of the origin of neurinomas is given in a very recent paper by Stout,[12] along with a bibliography on the subject.

The symptomatology of neurinomas is not of any special interest. Occasionally pain is noted; otherwise, pressure of the growing mass forms the principal complaint. Bleeding is not mentioned, generally, as one of the symptoms of neurinoma. Yet it seems worth noting that in the ten cases of neurinomas in the nose and nasal sinuses reported here from the literature, bleeding was a problem in four, and, as will be seen, was also a prominent symptom in the author's own case.

Neurinoma is a benign and well-encapsulated growth. Ewing[3] states that although relatively few have recurred after removal this is not always the case, and that various grades of malignancy may be encountered. All are agreed that these tumors are not susceptible to irradiation, and that surgical excision is the only effective treatment. Stout[12] concludes, after a study of many neurinomas, that although relatively few are malignant there are some schwannomas which are malignant. Stout[12] observed a malignant tumor which produced Schwann cells in vitro.

REPORT OF A CASE

The present case is that of a 33-year-old white man who entered Saint Mary's Hospital on November 10, 1947. He gave a history of recurring attacks of epistaxis from the left nostril during the previous two years. About 12 weeks prior to admission he became

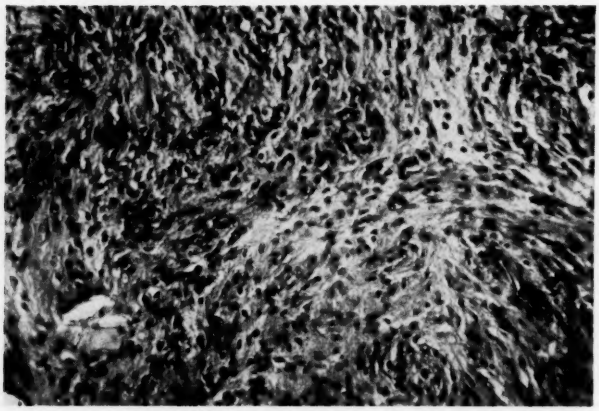

Fig. 1.—Photomicrograph of tissue removed from nasal cavity on September 23, 1947, showing interrelated bundles of spindle cells. The elongated nuclei show a tendency to lie parallel, spoken of as palisading. Note that intercellular fluid spaces are rather prominent in certain areas. (x 450.)

aware of complete obstruction of the left nasal passageway. Ten weeks prior to admission he had a profuse hemorrhage from the left side of the nose following a slight blow on the face.

On September 23, 1947, a portion of the tumor had been removed, intranasally, with a snare. Profuse bleeding followed immediately, and was controlled by packing. The tumor at that time presented itself as a soft polypoid mass of deep red color, completely filling the left nasal fossa. Sections of the tissue (Fig. 1) removed at that time were examined by a number of pathologists, but no diagnosis was made. The possibility of neurinoma was not considered.

Because of the marked vascularity of the tissue and the profuse bleeding which followed any manipulation, it was decided to use irradiation before proceeding with any further surgical measures. Consequently, between September 29, 1947, and October 7, 1947, the patient was given deep x-ray therapy at De Paul Hospital by Drs. E. C. Ernst and H. E. Muench: 800 roentgens to the left side of the involved area, 800 to the anterior aspect of the involved area, and 500 to the right side of the involved area, for a total of 2100, divided into eight treatments at daily intervals. On October 8, 1947, 50 mg.

of radium was placed in the tumor-bearing area of the left nasal fossa for six hours (300 mg. hours).

Upon admission to Saint Mary's Hospital on November 10, 1947, the tumor was still present in the anterior of the left nasal fossa, attached firmly to the nasal septum, to the inner aspect of the the left nasal bone and in the left ethmoidal area. At this time the tumor tissue was firm, somewhat lobulated, and light pink in color. There was no visible or palpable evidence of bone destruction in the external nose, maxilla, or orbital margins. The right nasal passageway showed nothing of interest. The eyes were normal on inspection and palpation. The pupils were round, regular and equal, and reacted to light and accommodation. Extra-ocular movements were normal. The nasopharynx was clear, and no tumor was seen in the left choana. The pharynx was normal. There were no palpable cervical lymph nodes or masses.

The remaining physical findings on admission to Saint Mary's Hospital were normal. There were no other tumors noted elsewhere in the body. Blood counts, urinalysis, blood chemistry, and Kahn tests were all within normal limits. X-ray examination of the nasal sinuses showed a faint soft shadow involving the left ethmoidal cells and left nasal fossa, with erosion of the frontal process of the left maxilla. Other nasal sinuses were not affected. X-ray films of the chest were clear. X-ray study of the skull, spine, ribs, pelvis, and long bones of the extremities failed to show any evidence of metastatic involvement in the bony structures.

Operative removal of the tumor was carried out on November 12, 1947, under intravenous pentothal sodium anesthesia. The nasopharynx was completely packed off with sponges, and an endotracheal tube introduced for an airway. A semicircular incision 4 cm. long was made, beginning at the inner third of the left eyebrow and extending medially and downward over the frontal process of the left maxilla in a curve parallel to the orbital margin. This incision was carried down through the periosteum to the bone. The periosteum was elevated and the left nasal bone, frontal process of the left maxilla, lacrimal bone, lamina papyracea and the adjacent part of the left frontal bone were exposed. Orbital contents and lacrimal sac were retracted laterally. The exposed bone was removed with gouge and bone punch, so as to enter the ethmoidal cells and left nasal fossa.

Tumor tissue was found occupying the upper anterior part of the left nasal fossa and the left ethmoidal sinuses. It was firmly at-

Fig. 2.—Photomicrograph of tissue removed at operation on November 12, 1947, showing a similar pattern to that in Fig. 1. Note that intercellular fluid spaces form a much more prominent feature of this later section; the tissue is more loosely textured than at the earlier date. (x 450.)

tached anteriorly to the inner surface of the left nasal bone, to the left side of the nasal septum, and to the superomedial surface of the inferior concha. The middle concha was absent and tumor tissue occupied all of the ethmoidal area and was attached laterally to the frontal process of the maxilla, lacrimal bone and lamina papyracea ethmoidalis. Tumor tissue extended posteriorly about two-thirds of the distance through the nasal fossa and superiorly as high as the cribriform plate. These skeletal structures had not been eroded, except the left nasal bone, which had been thinned out so as to crack under gentle pressure. The middle concha and all of the ethmoidal cells were lost in the growth itself. However, the lamina papyracea ethmoidalis was intact. The tumor was lobulated, smooth-surfaced, rather firm, light pink in color, and bled only moderately when cut.

All tumor tissue was excised and all surfaces where it had been attached were seared with surgical diathermy. The left maxillary sinus was inspected through the operative opening and it appeared to be free from tumor. The left nasal fossa was packed with vaselinized gauze. The orbital contents were allowed to fall into their normal position. The periosteal incision was closed with No. 0 plain cat gut interrupted sutures. The skin incision was closed with black silk interrupted sutures. A sea sponge was placed over the external

incision and bandaged in place to create gentle pressure. No drains were used.

The tissue removed was examined and studied in the Department of Pathology of the Saint Louis University School of Medicine, and the conclusions reached are quoted: "The microscopic examination shows interrelated bundles of spindle cells having a definite palisade arrangement. There are many large blood vessels which contain thrombi. Although the clinical behavior suggests rather rapid growth, the microscopic picture is not that of a frankly malignant tumor. Because of the location and of the clinical behavior the prognosis should be somewhat guarded. Diagnosis: Neurofibroma." (By Dr. H. Pinkerton.) (Fig. 2)

The patient had an uneventful postoperative course. Nasal and postnasal packings were removed 24 hours after the operation. Skin sutures were removed on the fifth postoperative day and the wound healed by primary union. Extra-ocular movements returned to normal in a few days as the swelling of the peri-orbital tissues subsided. The patient was dismissed from the hospital on November 22, 1947.

The patient has been seen from time to time since then, the most recent inspection being on March 3, 1949. The nasal mucous membranes have regenerated and covered the area denuded at the time of the operation. All the nasal mucosa on the left side has shown a tendency to atrophy since the operation, although this has not been as marked as was expected. There has been no return of the tumor.

SUMMARY

The nasal cavities and nasal sinuses are uncommon sites for neurinomas. Ten cases of neurinomas in the nasal cavity and sinuses are reported from the literature, and the author adds one case of his own. The reported case occurred in a 33-year-old male, and involved the ethmoidal labyrinth and corresponding nasal cavity. Bleeding was a prominent symptom and was also mentioned as a problem in four of the cases from the literature. After a partial excision, irradiation was carried out with no effect. At that time the true nature of the growth was not realized. The tumor was then excised completely and the patient has remained well for 16 months.

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XLIX

PAPILLARY SINUSITIS

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Papillary sinusitis is a hyperplastic inflammation of rare occurrence, and the total number of cases reported thus far in the literature is difficult to determine because of the various classifications and interpretations of the pathologic process at hand. Nevertheless, taking into consideration the combined clinical and pathologic findings with emphasis on the factors of chronicity and recurrence, a rather clear-cut entity is evolved.

REPORT OF A CASE

The patient, G. B., aged 67, first came under observation at this hospital in 1934. At that time he complained of nasal obstruction and discharge. Examination revealed reddened polypoid masses over the lateral walls of the fossae covering both middle and inferior turbinates. All the paranasal sinuses were found by x-ray examination to be densely cloudy. A polypectomy was performed, and the pathological sections were reported as squamous papillomata. The patient was discharged and did not return to the hospital until years later. Interim history revealed that numerous polypectomies, a bilateral ethmoidectomy, and a right Caldwell-Luc operative procedure had been performed. He stated that in 1939 a tender mass, which developed in the midfrontal region, opened and drained spontaneously. Surgery of the frontal sinuses at that time consisted of enlargement of the fistula and extirpation of polypoid masses from the frontal sinuses. There was temporary closure of the fistulous tract, and intermittent drainage through the fistula occurred until he was again admitted to this hospital in 1947.

The fistula was explored and the hyperplastic tissue was removed from the frontal sinuses for the second time. Pathological sections were reported as epidermoid and fibrous polypi. Following this surgical intervention, the patient developed a temporary right homonymous hemianopsia. Other neurologic findings except for anosmia were absent. Cautery excision of the granulomatous masses was performed five times over the subsequent six-month period, and since

Fig. 1.—Gross appearance of papillary hyperplasia through frontal sinus fistula.

then the progress of the disease has been limited by chemical cautery at biweekly intervals. During the latest hospitalization in October, 1948, for bronchopneumonia, bronchoscopy was performed and reported as "inflammatory changes of the tracheobronchial tree with no evidence of neoplastic disease." At present the patient wears a cosmetically colored prosthesis over the frontal sinus defect and leads an essentially normal life.

DISCUSSION

Chronic inflammations of the sinuses can be classified under five subdivisions; namely, (1) hypertrophic or polypoid, (2) sclerosing, (3) papillary, (4) follicular, and (5) glandular or adenomatous. This classification is considered the most complete by Eggston and Wolff.[3]

Billroth[1] first described nasal papillomata, but he erroneously declared that all nasal polypi were adenomatous. Hoppman[5] in 1883

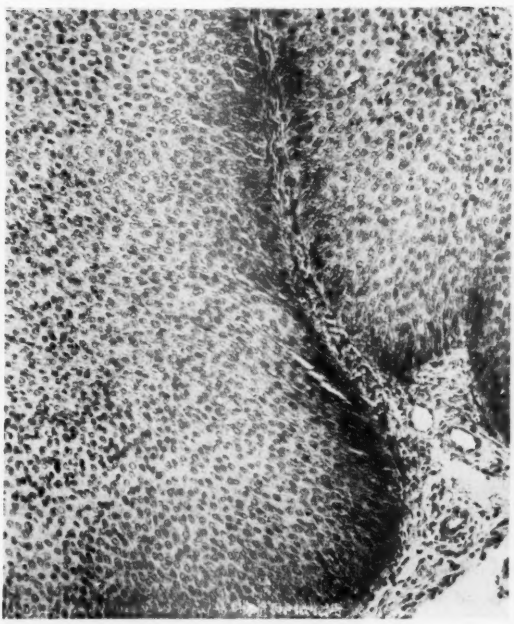

Fig. 2.—Microscopic appearance of the papillary hyperplasia.

described a number of these cases and studied them microscopically. Lacoarret and Moure in 1889 protested against the adenoma idea, declaring such tumors were merely hypertrophies of the mucous membrane or granulation tissue, and in 1891 Wright[6] pointed out that the mistake was one, more of nomenclature than of pathology. Since that time, it has been firmly established that the process is an inflammatory hyperplasia of the epithelium differing both in genesis and structure from that of a papilloma in the sense of Virchow, and papillary sinusitis is considered the most descriptive terminology. The papillary excrescences are soft, usually involving a large area of the nose and sinuses. The firm, hard type, in contradistinction, more nearly approaches the true neoplasm of the nose. The involvement of the middle and inferior turbinates may be extensions from the ethmoid sinuses, the most common site of origin, but the process is usually diffuse, variability is characteristic, and any or all of the sinuses may be diseased. The papillary hypertrophy often seen on the tips of the posterior turbinates in routine examinations is a type of papillary hyperplastic inflammation, not too unlike the pathologic picture be-

ing discussed. Initially, in the genesis of the process, a metaplasia from a pseudostratified columnar to a stratified squamous epithelium takes place. Frequently a mistaken diagnosis of papillary adenocarcinoma is made. Malignant degeneration occurs rarely. Recurrence is notable with persistent surface epithelial proliferation and extension without infiltration lasting many years unchecked by radical operations.

In the presence of obstruction, inflammatory exudate or liquid pus may be found. Grossly, the cryptlike processes of the papillae penetrating the stroma may give the appearance of cyst formation on cross section. The papillae may assume variable sizes and shapes. The microscopic picture, however, is more specific and descriptive of the true nature of the disease. Scattered throughout the hyperplastic epithelial cells and stroma are inflammatory cells. Abscesses filled with degenerated polymorphonuclear leucocytes may be seen, and cells with inclusions, so characteristic of a virus infection, may likewise be present. The structures are well differentiated with no invasive tendency, and a definite basal layer of cells exists. Destruction of bone by cause of increasing pressure occurs, but actual invasion of bone by epithelial growths proper is lacking.

The underlying cause is unknown. Eggston and Wolff[3] believe that the process does represent a virus disease although no proof exists outside the morphologic picture. The diffuse spread over the entire mucous membrane suggests a contagious factor, and there is a definite similarity to the multiple papillomata in the larynx of children and to venereal condylomata. Bacteriologic examination reveals a mixed infection with the number of organisms being increased above normal and being those organisms usually found in acute coryza. Hence, it is the opinion that they represent a secondary infection upon a virus disease which initiated the process.

There are no specific symptoms distinguishing this entity from the other causes of nasal obstruction and discharge. Anterior rhinoscopy will reveal a reddened granular papillary hypertrophy most often over the middle turbinate area. A purulent, occasionally hemorrhagic discharge is seen on the floor of the nasal fossa. Antral puncture, frontal cannulization, or Proetz displacement will yield similar returns. X-ray films reveal a homogeneous opacity or a corrugated hypertrophic membrane following lipiodol instillation of the paranasal sinuses. Bone destruction and fistula formation occur only in far advanced cases. Absolute diagnosis is obtained by local ex-

cision and microscopic examination. The recommended therapy is conservative; namely, local excision by electrical or chemical cautery, with emphasis upon the relief of nasal obstruction, maintenance of a free nasal airway, and reduction of secondary infection. Radical surgery is advised only in the presence of impending intracranial or intra-orbital extension, both of which are grave complications.

CONCLUSIONS

Since this disease is a papillary hyperplastic inflammation with numerous mitotic figures and a somewhat variable pathologic picture bordering on malignancy, it can be said that the correct diagnosis can only be arrived at by repeated biopsy study and that once a diagnosis is made, treatment still leaves much to be desired.

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A CASE OF MASTOIDITIS WITHOUT APPARENT OTITIS MEDIA

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AND

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A brief survey of the literature reveals that mastoiditis without preceding otitis media is no longer a rare condition, especially since the introduction of modern chemotherapy. According to Hempstead,[1] Dabrey in 1915 found in the literature reports of 24 cases. By 1929 the number of reported cases had increased to 146. By now the number of cases are so numerous that such reviews are unnecessary. Most of the instances seen nowadays represent a late flare-up following the cessation of chemotherapy. Hansel[2] has given a thorough discussion of the pathogenesis of this condition. This report, therefore, is limited to a case in point and to a discussion of those aspects which may help in making an early diagnosis.

This is an important consideration not only because of the neurological implications, but also because of its influence on growth in children.

REPORT OF A CASE

J. P. H., a 5½-year-old male, was admitted to the Pediatric Service of the Salt Lake General Hospital on February 10, 1947, because of pain and swelling behind the left ear. Aside from being thin and a poor eater, he had enjoyed good health until 30 hours prior to admission, at which time he awakened because of severe pain behind the left ear. He had been asymptomatic on going to bed the

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night before and slept well until awakened by the pain. Careful questioning by several examiners elicited no story of an upper respiratory infection for at least three weeks prior to the onset of the pain. The family recalled no knowledge of an otitis media for at least two and one-half years.

The child had been born spontaneously at term without difficulty. The only childhood illnesses were pertussis, measles and chickenpox all following one another after the age of six months, without complications. He was troubled by very frequent upper respiratory infections and sore throats prior to removal of the tonsils and adenoids in January, 1946. Occasional earaches accompanied these colds and a bout of left suppurative otitis media occurred at the age of three.

At the time of his tonsillectomy and adenoidectomy the left drum was described as being reddened and retracted, but in the outpatient follow-up in May, 1946, the tympanic membrane was described as being of normal appearance. A slight deviation of the nasal septum to the left was also noted. We feel that this medical record of his past difficulties is complete as the child was never seen by an outside doctor, and all his medical care was obtained in the Outpatient Department of this hospital. His family history is noncontributary.

On admission, examination revealed a temperature of 100.4° F. by mouth, pulse 100, respiration 28, blood pressure 90/60. His weight was 40 lb., height 44 in., and Wetzel Grid M-31-67%. He was a small, thin 5½-year-old boy looking acutely ill and preferring to lie on his right side. He was fully co-operative, but kept complaining of pain behind the left ear. There was redness and swelling over the left mastoid process. The tenderness in this region was extremely marked. There was a slight enlargement of the posterior cervical lymph node chains, but no palpably enlarged nodes in the region of the mastoid or tip of the mastoid process. Both canals were clear and the drums intact. They were slightly scarred, but retained their normal landmarks. There was no redness nor fullness. The hearing was grossly normal. There was no difference in the appearance of the two drums. The pharynx was somewhat injected, and the nose was not remarkable. Heart, lungs, abdomen and the remainder of the examination showed no abnormalities. The reflexes were normal.

The white blood count was 5,500, showing on differential 61% polymorphonuclear leucocytes, 1% eosinophils, 52% lymphocytes

and 5% monocytes. The hemoglobin was 14 gm. with a hematocrit of 42 mm. The sedimentation rate (Wintrobe method) was 43 mm. for the first hour. The urine was normal. The serology and patch test were negative. Roentgen ray examination demonstrated marked sclerosis of both antra with poor development of the peri-antral cells. There was a tiny filling defect in the right antrum and a larger defect in the left, measuring 2 cm. by 1.8 cm. in diameter.

The patient was placed on penicillin therapy, 30,000 units intramuscularly every three hours; and 2 gm. sulfadiazine every 24 hours in divided doses, 1 gm. being given initially. With this chemotherapy, his temperature dropped to normal, and he remained afebrile for the remainder of his hospitalization. The pulse varied between 106 and 120 for two days and then decreased to between 90 and 100 after the third day. There was only partial resolution of the swelling, redness, and tenderness over the left mastoid. Three days after admission he was taken to the operating room and the left mastoid was opened. An area of osteomyelitis filled with old inspissated pus was found lying over the antrum and extending downward toward the tip just behind the descent of the facial canal. The pus was so old and thickened that in places it resembled fecal material. A few granulations were found extending from this cavity to the aditus ad antrum, but the middle ear looked clear.

Cultures were made of the material removed, but nothing was grown aerobically or anaerobically. The postoperative course was uneventful. The wound healed by primary intention. Four days postoperatively the penicillin was discontinued, but the sulfadiazine was given until the eighth postoperative day, at which time the white blood count was 4,600. At no time did the tympanic membranes lose their normal appearance, nor was there any evidence of impairment of hearing. He was discharged ten days after the operation in good condition without complaints. At the follow-up examination in the Outpatient Department three weeks later, he reported that he had been back to school and resumed all his activities without any difficulty. He was in excellent health with good appetite and general well-being. At that time the left drum looked entirely normal. His weight was 42½ lb., height 44½ in., and Wetzel Grid M-37-67%.

A second follow-up visit a month later showed him continuing in perfect health, gaining weight and growing remarkably rapidly. The ear and operative scar were both well healed. There were no upper respiratory infection complaints or evidences of infection seen. His weight was 43 lb., height 45 in., Wetzel Grid M-38-67%.

At a four-month postoperative follow-up, the same conditions of very good health prevailed. He was a much better eater and sleeper than he had ever been before, and it was said that he played better and was much less "nervous" than he had been previously. He was still free of upper respiratory infections and the drum was normal in appearance. The weight at this time was 44¾ lb., height 46 in., and Wetzel Grid M-44-15%. After this visit, he was discharged from the Outpatient Department as having recovered fully.

A follow-up visit two years postoperatively showed a persistence of the improvement. His general condition, appetite, sense of well-being, ambition and endurance had all appreciably increased. He had gained 15 lb. and grown 6½ in. since the operation. The Wetzel Grid was B-66-15% which, while maintaining about the same channel, shows the continuing improvement in the Auxodrome.

DISCUSSION AND CONCLUSION

In the case considered the child at the age of three had an uneventful recovery from an attack of otitis media following treatment by adequate dosage of sulfathiazole, tonsillectomy and adenoidectomy. Although no pathological condition could be found on repeated examination by several physicians, his developmental progress was poor for the next 2½ years. The cause was discovered only when a subperiosteal abscess appeared literally overnight. Roentgenologic examination and surgery showed that the osteomyelitic process in the mastoid was of long standing. It is felt that the child's developmental failure was due to a residual mastoid cell infection remaining after subsidence of the suppurative otitis media. The gain of six units on the Wetzel Grid in the month of convalescence following the operation and the maintenance of improvement for the next two years, lend support to that belief.

It was fortunate that the spread of the infection from the osteomyelitis was outward to the periosteum rather than inward to the dura or lateral sinuses with serious neurological complications. Neurologists have often postulated that a silent type of mastoiditis might be a rare cause of intracranial infection. This case supports that contention.

In children with poor growth and development, the possibility of the defect being due to a chronic infection must always be considered. With the advent of the picture of unsuspected mastoiditis this possibility must be kept in mind during the focci search. Routine roentgen rays of the mastoids should be considered in every case

where there has been a history of otitis media treated successfully with chemotherapy but where growth has remained impaired thereafter. The earliest possible discovery of such a condition is extremely important, not only because of the impairment of normal growth and development, but also because of the danger of neurological complications in neglected cases.

SUMMARY

1. Occasional cases of mastoiditis without immediately preceding otitis media have been reported. This condition has increased in frequency since the advent of chemotherapy and antibiotics.

2. A case is reported of a child under observation for malnutrition who suddenly developed a subperiosteal abscess. The middle ear and hearing were normal clinically and at operation.

3. In a child with poor development the possibility of the retarding focus being an unsuspected mastoiditis should be kept in mind. Routine roentgen rays of the mastoids might be advisable.

4. Early discovery of such a condition is extremely important because of the obvious neurological implications.

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Scientific Papers of the American Laryngological Association

LI

PRESIDENT'S ADDRESS

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I wish to express my sincere appreciation for the privilege of serving as your Chairman this past year, the 70th in the history of this society. No one could be unmindful of the great honor of being President of the American Laryngological Association.

The major portion of these remarks will be devoted to consideration of some of the broader applications of laryngology to the hospital and to other branches of medicine, to be followed by some thoughts as to the future of our specialty. Before taking up the main theme, certain references to the past would seem in order. The American Laryngological Association has a heritage of seventy years of distinguished service devoted to the advancement of laryngology. We are rightfully proud of this record and the accomplishments of these men of earlier days who are responsible for it. And so we endeavor to preserve the traditions of these seventy years.

I don't mean a slavish adherence to the past with a disregard for progressive ideas. Rather do I refer to a deference to time-honored customs, to the ideals upon which our Association was founded and to a recognition of the contributions of our predecessors. Tradition of the right kind is a good thing to tie to, especially so in these days, when we see many of our philosophies threatened by various and sundry radicalisms, untested and unproven, and dangerous in their implications.

Read before the meeting of the American Laryngological Association, New York City, May 16-17, 1949.

Medicine has been defined as an art with a scientific background. We must not forget that this background rests upon a foundation of the labors and experiences of years of scientific study. While incidence may change and characteristics may vary, there are no new diseases other than those which are man-made. Many of our accomplishments which we hail as great discoveries either have been achieved before, perhaps less efficiently but under greater handicaps, or have developed upon the basis of past work, often-times forgotten. Each generation has its torch-bearers and the brilliance of illumination varies only with the perspective.

Some time ago, I became interested in certain phases of hospital administration. This was an educational experience. I learned how little I knew about many things I previously had taken for granted. It was a natural step from this into active participation in the work of state and national hospital associations, something I never have regretted. I came to know what fine, unselfish, altruistic people there were in the hospital field. I feel that I gained a better and broader conception of this problem of caring for the sick. It is perhaps only natural that the clinician, concerned only with his own patient, so often fails to appreciate what is entailed in an adequate program of hospital care for that patient. He gives little thought to the financial problem of providing the stand-by service of building and equipment, of personnel, and of maintenance. At times he may give the impression that the hospital is dependent upon him, little realizing that without the hospital he would be quite unable to practice anything else than the most rudimentary medicine. Not only is the hospital of today a big business with all that this term implies; it must efficiently co-ordinate all professional services in order to maintain the highest standards, safeguarding the interests, the health and often the life of the patient.

One might compare the hospital to a symphony orchestra. In the orchestra, in order to effect a satisfactory performance, each member must play in harmony and in time under the conductor's baton. Doctors are natural soloists; specialists, notoriously so. And while the surgeon may solo in certain operating-room passages and the obstetrician may strike high C and perhaps sharp it a bit in the delivery-room, all must play together in tutti measures under the administrators' leadership. Otherwise there are bound to be discords, disastrous to both the patient and physician.

There is hardly a hospital program which does not devote considerable time to discussions of staff problems. It seems unfortunate

that so often the physician is considered the problem child of the hospital family, and this is probably due to mutual lack of understanding. During the three years I served as President of my State Hospital Association, I earnestly endeavored to interest all staff members, as well as trustees, in becoming members of the Association and in taking active part in its proceedings. A better understanding of hospital problems by all concerned, doctors and trustees, could not help but make for better standards of professional service.

Dr. Mosher repeatedly has urged that one be bigger than his specialty. To me, this means having the broadest possible conception of the practice of medicine, while confining one's actual work to that field in which one is trained and is considered competent. It might be phrased as being diagnostically broad and therapeutically limited. This requires constant association with men in other fields of medicine, thinking of the patient as a whole rather than any limited anatomical part thereof. It means group practice in the best professional sense, the pooling of all skills necessary for an adequate conception of any clinical problem. Unfortunately, most discussions of group practice have placed too much emphasis upon the economic phase, rather than on the more important objective of better medical service.

For years, the larger teaching hospitals have embodied the principles of group practice in the care of service cases. An outstanding feature in our changing professional relations in hospitals has been the gradual extension of this principle to all patients, private as well as service. It has been the logical thing to pool professional resources in the hospital. This should mean the group study of cases whenever indicated, the liberal use of consultations, and transferals to other services or physicians if the patient would benefit thereby.

Recently, I have been severely criticized, in the publication of one special society, for stating that the principle that the hospital should assume the responsibility for the safety and medical care of its patients is becoming gradually recognized. I stand by this statement, at least insofar as it refers to our best hospitals and most conscientious physicians. This does not mean that the hospital is attempting to practice medicine, but it does mean the members of its staff practicing it together. It means substituting co-operation for competition. It means a share of responsibility whenever indicated. It does not decry resourcefulness in meeting emergencies but it does eliminate attempting to play God when unnecessary.

It means that the private patient is not to be considered as the personal medical property of his physician, for him to do with as he may see fit. Rather, he is the hospital's patient, under the care of the physician, to be sure, but with the hospital, through its staff, being responsible for correct diagnosis and proper therapy. Medicine is not an exact science; no man is infallible and errors at times are bound to occur. The consensus of medical minds of the staff, by hospital policy, should be available to determine whether, or not, correct treatment is being carried out. The hallowed status of the physician who, under no circumstances should be criticized or interfered with in his relations with his private patients, still casts a shadow in many a hospital. And many a misdeed is perpetrated under the guise of ethics. Ethics is the science of morals and a hospital policy which does not consider the welfare of the patient as paramount would hardly seem to be truly ethical.

While this principle of the hospital assuming the responsibility through its staff for the medical care of its patients may seem revolutionary to some, it must be accepted if we are to assure the patient of the best possible care. And this, of course, is group practice in the hospital. And it is not new or revolutionary. This is simply the adaptation to all patients of the accepted principles of what we have termed the "teaching hospital," which has produced the best type of medicine the world has ever seen.

One might say that this is hardly a concern of this Association. We have been interested in the scientific advancement of laryngology. But, our members almost universally occupy senior positions as heads of departments, many of them in our leading institutions, and therefore should be able to exercise considerable influence in determining hospital policies. Perhaps unconsciously we have adopted the cloistered attitudes of the ivory tower and have given too little thought to the larger over-all problem of providing adequate care for the sick. The specialist is often the supreme example of the isolationist.

Medicine, as we have known it, is facing serious threats today. We hear criticisms of the cost of medical care and of the inability of many people to obtain adequate medical care. Actually, the most justifiable criticism is the cost of poor medical care, the toll of mistaken diagnoses, or diagnoses made too late, or the results of inadequate therapy. These, too often, produce costs that never can be met, costs in lives sacrificed, or irreparably damaged. The promised panacea of political or government-controlled medicine would seem hardly the answer from all evidence at hand, yet it makes palatable political fodder.

Knowing that we have been doing our own particular job to the best of our ability, we have tended to remain aloof, satisfied that somehow a solution to this problem would be found. It is well to keep in mind that "nothing is so blind or insecure as the status quo."

The voluntary hospitals of the country, with the expansion planned for under the Hospital Survey and Construction Act, could provide hospital care and medical service of a standard to meet the demands of our people, and one comparable to that of our best institutions. They are desirous of providing this care but need the help and support of the best minds in the medical profession, such as are represented here today. Much could be accomplished by an active participation on our part in the work of our hospital associations. Should not we, specialists though we be, come down from our ivory tower? Should we not do all in our power to keep medicine free of politics?

In closing, I cannot refrain from some allusion to the changing character of our specialty. We hear criticisms that it represents a shrinking field; that antiobiotic and chemo- therapy have eliminated many of the demands for formerly common surgical procedures; that a better understanding of nasal physiology has lessened the frequency of much sinus surgery; that many facial plastic and endoscopic procedures are being lost to other specialties. The span of human life is far too brief to gain a true perspective of any era. Changes are inevitable; there always have been changes. And medicine, like life itself, is never static. I cannot agree that ours is a shrinking field; that our ambit is diminishing. There is nothing shrinking about it except possibly with our own mental processes. It is a changing specialty, just as medicine itself is changing, constantly changing. New discoveries gradually eliminate old procedures. New knowledge modifies older methods. And no single group has any monopoly on techniques, or should be dependent merely on technical ability.

This should mean that our horizons are broadened rather than narrowed. Any advance in medical knowledge which will lessen morbidity or decrease mortality benefits all, both patients and physicians. Due to these developments we should be better able to devote more time and effort to the wider application of our specialty, and to become better physicians and less mere surgical technicians. To those of us who are hyphenates, practicing the twin specialty, the marked decrease in the incidence of surgical mastoiditis and its complications should allow for a more careful consideration of the

many problems incident to hearing impairment, to prevention whenever possible, and to rehabilitation.

The recognition of nasal physiology and the consequent decrease in radical sinus surgery should allow time and stimulation for the study of underlying conditions, including a truly scientific approach to the problems of the allergic state, and to autonomic dysfunction. We blithely remove hypertrophic lymphoid tissue from the pharynx, but pay little attention to the possible causes of such hyperplasia. And while we seek an answer to the problem of cancer, many cases are still undiagnosed during the period when surgical removal would give a better prognosis and would result in less physical handicap to the patient. The salivary glands and their diseases, and infections and tumors of the neck have too long been accorded scanty attention, if not entirely neglected. These, as well as many other conditions, should be our responsibilty. We still have problems and there is abundant opportunity for work in our field, if we seek its widest application and explore it intensively.

PROFESSIONAL BUILDING.

LII

FACTORS INFLUENCING THE GROWTH OF LYMPHOID TISSUE

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At the outset, may I express my appreciation and thanks for the invitation to address the American Laryngological Association. I suspect that this invitation is a result of my interest in the structure and function of lymphoid tissue. This interest apparently interdigitates with that of some members of this association, particularly in relation to the factors concerned with the size of lymphoid tissue. It is, therefore, my pleasant task to discuss with you some results obtained in studies of the regulation of lymphoid tissue growth. It should be made clear, however, at the beginining of this discussion that the data to be presented, obtained in the laboratories of other investigators, as well as our own, have been derived from experiments with laboratory animals. Nevertheless, it may perhaps be profitable for us to consider available information regarding the growth of lymphoid tissue in experimental animals, since it is from animal investigations that will stem observations which may have some practical application in man. Moreover, these applications will be made by members of this Association, and their colleagues, as a result of an evaluation of the significance of the experimental data against the background of clinical experiences.

The factors which affect the growth of lymphoid tissue may be listed in three broad categories: (1) diet, (2) endocrine secretions, and (3) stimuli other than hormonal, which may arise either within or outside of the organism. In addition, there are suggestions in the experimental literature that a genetic factor may modify the growth of lymphoid tissue.

Let us begin a consideration of the factors which influence the growth of lymphoid tissue by focusing our attention on the endocrine

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glands. The role of hormones in the regulation of lymphoid tissue size is discussed first since, as will be seen shortly, information available on this topic aids in explaining some of the effects of the other two factors, i.e., diet and nonhormonal stimuli, on lymphoid tissue.

Suggestion of a relationship between the size of lymphoid tissue and an endocrine gland, the adrenal cortex, was noted in the early descriptions of Addison's disease, in which hypertrophic changes in the lymphatic tissues were sometimes evident at autopsy. Within the last 20 years, numerous investigators have found that the secretions of the adrenal cortex may affect the size of the thymus gland. Injection of potent adrenal cortical extracts, or of certain adrenal cortical steroid hormones, resulted in involution of the thymus. On the other hand, experimental removal of the adrenal glands in animals led to lymphoid tissue hypertrophy.

It is well at this time to recall that the size and secretory rate of the adrenal cortex are under the control of the trophic hormone of the adenohypophysis, namely, adrenotrophin. In the animal from which the hypophysis has been removed by operation, there occurs an atrophy of the adrenal cortex, and a resultant inadequate production of its hormones. The restoration of the structure and function of the adrenal cortex of the hypophysectomized animal may be achieved by injection of either hypophyseal adrenotrophin, or hypophyseal extracts which have adrenotrophic hormone activity. Administration of excessive amounts of such preparations leads to manifestations of augmented adrenal cortical secretion, including lymphoid tissue involution. This is shown in data obtained in a study[1] of the effect of daily injections of adrenotrophin for 15 days into mice of the CBA strain (Strong). The reduction in lymphoid tissue size produced by chronic adrenal cortical stimulation may be contrasted with the lymphoid tissue hypertrophy occurring in circumstances of inadequate adrenal cortical secretion, as in the adrenalectomized animal.[1]

The marked decrease in size of lymphoid tissue induced by adrenal cortical hormones is based on profound histologic changes[2] in all tissues and organs containing lymphoid elements, e.g., thymus, lymph nodes, spleen and Peyer's patches. Within a few hours after a single injection of adrenotrophin, or of one of the adrenal cortical steroids which is oxygenated in position 11 of the steroid nucleus, there is a dissolution of medium-sized and small lymphocytes within the lymphoid tissues. This is accompanied by a marked edema, and

is characterized by karyorrhexis and pycnosis of the cells. There is also an increased development of immature plasma cells.

Dissolution of lymphocytes is maximal between one and six hours after hormone injection in both mice and rabbits. This is then followed by a development of numerous macrophages in all of the lymphoid organs. These macrophages contain large amounts of ingested material as a result of their phagocytic activity in removing the cellular debris arising from the dissolution of lymphocytes. The phagocytic reaction is not unlike that following a bacterial invasion or injection. Within six to nine hours after administration of either adrenotrophic or adrenal cortical hormones, most of the nuclear fragments scattered about in the lymphoid tissues have been phagocytized, and there is little evidence of further lymphocyte dissolution. During this period and subsequently, the edema has subsided and there is evident the beginning of a return to normal lymphoid structure. The period of recovery is characterized by differentiation of lymphocytes from reticulum cells and resumption of mitosis in lymphocytes. Within 24 hours after a single injection of hormone, the lymphoid structures, with the exception of the thymus, usually contain normal numbers of lymphocytes. This series of histologic events may be repeated following another injection of hormone, although small hyperplastic lymph nodes may result from prolonged hormonal administrations. It seems clear from the evidence presented that at least one endocrine gland, the adrenal cortex, controlled in its secretory rate by the adenohypophyseal adrenotrophic hormone, influences profoundly the size of lymphoid tissue.

The control exerted by hypophyseal adrenotrophin over the secretory rate of the adrenal cortex is of particular interest in evaluating the relation of this endocrine gland to the size of lymphoid tissue, since a wide variety of unrelated stimuli are now known to augment the rate of secretion of adrenotrophin.[3] Thus, exposure of the organism to environmental influences such as cold, heat, or anoxia, to traumatic conditions such as tissue injury, fractures or hemorrhage, to bacterial toxins, to toxic chemicals, e.g., arsenic or benzene, to anesthetics, e.g., nembutal, to foreign proteins, or to minute amounts of a variety of substances normally produced in the organism, such as histamine, insulin, epinephrine and thyroxine, will produce an increased rate of secretion of hypophyseal adrenotrophin. As a consequence, there results an augmented production of adrenal cortical steroids and an accentuation of those processes which are influenced by these steroid hormones. The accelerated release of

adrenal cortical hormones, as a result of any one of these stimuli, does not occur in the absence of the hypophyseal adrenotrophic hormone. These observations serve to explain why the various physiological alterations which are affected by pituitary-adrenal cortical secretion may be seen to a qualitatively similar extent in response to a wide variety of agents and in diverse circumstances. This endocrine mechanism is undoubtedly the physiological basis for the so-called "accidental involution" of lymphoid tissue, and for the decrease in lymphoid tissue size seen in the "alarm reaction" of Seyle,[4] inasmuch as stress, whether physical or chemical, is one of the potent activators of pituitary-adrenal cortical secretion. Thus, the fact that the histological and physiological responses of lymphoid tissue are so greatly influenced by a particular endocrine mechanism, the hypophyseal-adrenal cortical relationship, which in turn may be augmented by many stimuli, suggests a reason for the difficulty in finding uniformly, at biopsy or autopsy, a so-called normal appearance of lymphoid structures. It would appear that the latter are, literally, in a state of continuous histological and physiological flux in response to continual variations in the secretory rate of the pituitary-adrenal cortical mechanism. This rate is, in turn, influenced markedly by a variety of diverse stimuli which may have their origin either within the organism or in its environment.

It should be emphasized that stimuli operating independently of the pituitary-adrenal cortical mechanism may influence profoundly the size and structure of lymphoid tissue. This is evident from experience which shows that certain agents may cause lymphoid tissue involution in the absence of the hypophysis or the adrenals. For example, exposure to x-radiation, or injection of either a nitrogen mustard, urethane, or desoxypyridoxine, results in lymphoid tissue involution in the hypophysectomized or the adrenalectomized animal. Thus, a direct effect of any one of these agents on lymphoid tissue without endocrine mediation is well established. It may be pointed out, however, that in the intact animal, a portion of these effects may be endocrine mediated, since these toxic agents do augment pituitary-adrenal cortical secretion.[5]

A striking example of the profound role which the pituitary-adrenal cortical mechanism may play in the normal organism, even in circumstances in which the stimulus can affect lymphoid tissue without endocrine mediation, is seen in the case of x-radiation. It has been established that x-radiation, in common with a variety of other types of stimuli, also augments pituitary-adrenal cortical secretion.[6, 7] However, it is also clear from the experimental data that while small

doses of radiation may exert their effects on lymphoid tissue structure and function only by way of the pituitary-adrenal cortical mechanism, larger radiation doses produce alterations in lymphoid tissue either in the presence or absence of the pituitary or the adrenals. Indeed, x-radiation is one of the most useful methods of producing localized lymphoid tissue involution, since by careful shielding of all except the area which it is desired to radiate and with proper choice of dosage, the effects of the radiation can be largely restricted. However, attention should be directed to the fact that even in circumstances of extensive protection of most of the organism, there may be a generalized effect of radiation on lymphoid tissue via pituitary-adrenal activation. This is seen most strikingly in the experiments of Leblond and Seegal.[8] These investigators observed that exposure of only the posterior one-third of normal rats to x-rays caused generalized lymphoid tissue involution. However, very large radiation doses given to adrenalectomized animals, shielded in all but the thymic area, produced alterations only in the exposed thymic tissue. These experiments are an illustration of the fact that generalized lymphoid alterations, seen following exposure of a circumscribed area to x-radiation, may be endocrine mediated.

The experimental use of x-radiation has also provided further emphasis of the role which the adrenal cortical hormones play in the normal organism in restricting abnormal enlargement of lymphoid tissue. Mice given a single dose of 200 r show significantly smaller lymphoid structures, as compared to untreated mice, for as long as 48 to 72 hours following exposure. In contrast, adrenalectomized mice, given the same radiation dose, show extremely rapid restitution of lymphoid tissue. Within 24 hours following exposure of adrenalectomized mice to 200 r, the lymphoid tissue had not only regained its normal size, but had attained the typically hyperplastic appearance characteristic of the adrenalectomized animal.[6] In other words, the rate of accumulation of lymphoid cells is enormously greater in the absence of the adrenals. On the other hand, since in intact animals exposed to single, high radiation doses, the lymphoid tissue is maintained in the involuted state for several days, there must be occurring a prolonged augmentation of pituitary-adrenal cortical secretory activity. Thus, although the lymphoid tissue involution was induced initially largely as a result of the direct action of x-radiation on lymphoid cells, the postradiation period is characterized by enhanced activity of the endocrine mechanism, with its attendant restriction of lymphoid tissue growth. These data illustrate the intimate relationships which may obtain between direct and indirect

effects on lymphoid tissue, elicited by the same agent, for example, x-radiation.

In considering endocrine glands other than the adrenal cortex, which may be concerned with the regulation of the size of lymphoid tissue, perhaps the next best evidence can be assembled for a relationship between the sex glands and lymphoid tissue mass. The well known involution of lymphoid tissue, which occurs at puberty, is a long-established observation. For example, the involution of the palatine tonsils seems to begin about the age of 15. The thymus gland undergoes marked involution concomitant with the attainment of sexual maturity.

In the case of the estrogens, these steroid hormones appear to exert a two-fold influence on lymphoid tissue. Small doses of these hormones may increase the output of pituitary adrenotrophic hormone, and this can account for the typical involution of the thymus, which may be produced experimentally by the injection of estrogens. However, prolonged administration of the female sex hormones leads subsequently, in the thymus, to active growth of an epithelial nature. With respect to other lymphoid tissues, it has been demonstrated that chronic estrogen administration, either by injection of the hormone, implantation of pellets, or painting of the skin with estrogens, produces a local or general enlargement of lymph nodes and thymus gland, and that ultimately, provided the animal does not die from the effects of hormone overdosage, there may be produced lymphoid tumors.[9] A genetic factor appears to exert an important influence in this connection, inasmuch as some strains of highly inbred mice are much more susceptible than others to the induction of lymphoid tumors by estrogens. It is interesting in this connection that the total amount of lymph nodes and splenic lymphatic tissue is generally greater in female than in male experimental animals. The sex difference is most pronounced, generally, for the thymus.

The male sex hormone, testosterone, also has been observed experimentally to exert a marked influence on the size of lymphoid tissue. Castration has been reported to cause a highly significant enlargement of lymphoid structures, while the injection of male sex hormone has caused involution of lymphoid structures. The influence of the gonads in the regulation of the size of lymphoid tissue is seen in recent observations in fasting, castrate mice.[10] The marked involution of lymphoid tissue occurring as a result of a stress, in these experiments inanition, was found to be reduced in severity by prior gonadectomy. Apparently, the castrate animal, when exposed

to stress, does not respond with a normal degree of pituitary-adrenal cortical secretory activity.

As for the possible influence of other endocrine secretions on the growth of lymphoid tissue, at least two of these, namely, insulin and epinephrine, are known to augment pituitary-adrenal cortical secretion, and may, therefore, indirectly bring about an involution of lymphoid tissue. The active secretion of the thyroid, controlled by the thyrotrophic hormone of the adenohypophysis, may acutely cause reduction of lymphoid tissue size as a result of stimulation of adrenotrophin secretion. Chronically, however, thyroid secretion appears to stimulate the growth of lymphoid tissue, since enlarged lymphoid structures have been observed in experimental thyroid feeding and in clinical hyperthyroidism.

From the foregoing, it seems evident that a wide variety of endocrine influences may alter the size and structure of lymphoid tissues. The important role which these endocrine secretions play in the normal physiology of the organism, and the wide variety of factors which influences the concentration of these circulating hormones, all point to intimate relationships between endocrine glands and the size of lymphoid tissue.

Let us turn now to a consideration of the role of diet in the regulation of the size and structure of lymphoid tissue. At least two dietary factors have been demonstrated to affect the growth of lymphoid structures. These are: (1) the caloric intake, and (2) the protein content of the diet. With regard to calories, it is obvious that growth, whether it be of the entire organism or of a specific tissue, i.e., lymphoid organs, is an energy-requiring phenomenon. Consequently, an adequate caloric intake is essential for the promotion of growth. In addition, it has now been established that caloric restriction exerts an effect on lymphoid tissue which is unique in its intimate relationship to pituitary-adrenal cortical secretion. One of the oldest of experimental observations is the marked involution of lymphoid tissue, which occurs as the result of partial or total inanition. Indeed, inanition has been used by histologists for many years for the purpose of producing involution of lymphoid tissue with the view of providing so-called "washed-out" or depleted lymphoid structures for histological examination by students. Since acute or chronic inanition has been shown to be a potent activator of pituitary-adrenal cortical secretion, it was considered possible, as a working hypothesis, that an increased concentration of circulating adrenal cortical steroids is the basis of the striking lymphoid tissue involu-

tion caused by acute or chronic inanition. Experiments designed to test this hypothesis have been conducted in fasting mice.[11] Normal mice of the CBA strain (Strong), subjected to a 48-hour fast, show a decrease of at least 35% in lymphoid tissue weight and nitrogen content, as compared to normal, fed animals. At the same time, there occurs the often-observed loss of weight and nitrogen from the liver and remainder of the body. On the other hand, adrenalectomized mice, fasted for a comparable period of time, show no loss of lymphoid tissue weight or nitrogen content, although decreases in the liver and other tissues of the body are seen, as in the non-operated, fasted mice. Therefore, in the absence of the adrenals, the fasting animal is unable to obtain readily the direly needed nitrogen present in its lymphoid tissue. It seems clear, therefore, that the total caloric intake is an exceedingly important factor regulating the size of lymphoid tissue, and that the involution of these structures, which occurs in circumstances of partial or complete restriction of food intake, is based upon the sensitivity of the pituitary-adrenal cortical secretory mechanism in its response to restricted caloric intake.

In connection with the described experiments in fasting mice, recent studies have been conducted on the influence of purified hypophyseal growth hormone on fasting metabolism.[12] The growth of lymphoid tissue, which is seen following adrenalectomy, occurs even in the fasting animal, notwithstanding the obvious drain on the energetic resources imposed by the fast. This growth of lymphoid tissue in the fasted, adrenalectomized animal could not be potentiated by growth hormone. Thus, the specific role of the adrenal in regulating the structure and function of lymphoid tissue gains emphasis from the failure to influence this tissue with growth hormone, which has, in general, a nitrogen-sparing effect in the fasting animal.

In addition to the caloric intake, it is clear that the protein content of the diet may be a prime factor in determining the size of lymphoid tissue. In the first place, in circumstances of an inadequate dietary content of protein, there is generally a diminution in appetite, and this partial inanition may, in itself, lead to lymphoid tissue involution via stimulation of the pituitary-adrenal cortical mechanism. Secondly, protein, per se, is required in order to provide the construction material necessary for the synthesis of the protoplasm of new lymphoid cells. Insofar as is known at the present time, the requirements of lymphoid tissue for protein are not unlike those of other structures, i.e., a minimum amount of protein nitrogen must be available in the diet, and the quality of the protein must be nu-

tritionally adequate; that is to say, the so-called ten essential amino acids which cannot be synthesized readily by the organism must be available in the dietary protein. The role of protein in the synthesis of lymphoid tissue is seen specifically in the studies of Cannon and his associates[13, 14] at the University of Chicago. Using antibody production as an index of measuring the synthetic capacity of lymphoid tissue, these investigators demonstrated a diminished rate and degree of antibody synthesis in rabbits maintained on a restricted protein intake.

A further manifestation of the requirement of lymphoid tissue for protein or protein components may be seen in the recent demonstration[15, 16] that a severe atrophy of the thymus occurs in paired-fed rats given a synthetic diet lacking in either phenylalanine or leucine, two of the so-called essential amino acids. Moreover, attention should be directed to the experimental evidence[17] that restriction of a diet in its cystine content caused reduction of the incidence of methylcholanthrene-induced leukemia in CBA mice.

Thus, it would appear that the rate of growth of lymphoid tissue can be restricted by limiting the intake of protein or essential protein constituents. In this regard, therefore, lymphoid tissue physiology bears a similar relationship to dietary protein as do other cells of the organism, in that nitrogen of a correct quality and quantity must be available.

The importance of diet in the growth of lymphoid tissue has been emphasized further by the apparently high requirement of this tissue for one of the vitamins, pyridoxine. The investigations of Stoerk and his associates[18, 19] have demonstrated a marked involution of lymphoid tissue in rats maintained on a pyridoxine deficient diet. This effect was apparently not due to the diminished food intake or to the mediation of other factors, e.g., endocrine glands. Furthermore, when the pyridoxine content of the diet was very low, the administration of desoxypyridoxine, a pyridoxine antagonist, resulted in a failure of transplanted lymphosarcomas to grow, as well as a regression of established tumor transplants.[20]

Little is known about the possible influence of other dietary components upon the size of lymphoid tissue specifically. Carbohydrates and lipids of the diet can, of course, supply the energy required by the diverse synthetic mechanisms which are concerned with new lymphoid cell construction. It is also clear that in cir-

cumstances in which excessive or extra amounts of lipid are processed, there is a generalized sparing of the proteins of the tissues, including those of lymphoid structures.

From the evidence which is available, it may be concluded that the size and the rate of growth of lymphoid tissue are influenced markedly by endocrine and dietary factors, as well as by a variety of physical and chemical stimuli, many of which exert their effects via an endocrine mechanism, namely, the pituitary-adrenal cortical axis. In addition, the response of lymphoid tissue to dietary, endocrine and other factors may be modified by a genetic factor.

In conclusion, let us look briefly at the suggested functions of lymphoid tissue, inasmuch as the quantity of this tissue may bear a relationship to its capacity to fulfill its normal functions. It is well recognized that lymphoid tissue and the lymphocyte have a role in resistance. The fact that the lymphocyte is one of the end cells on which adrenal cortical hormones exert an influence serves to integrate the roles of the lymphocyte and the adrenal cortex in resistance. In the immunized animal, lymphocytes contain antibody globulin,[21-23] and these immune proteins may be synthesized in lymphoid structures. In addition, lymphocytes may function in the attenuation of viral agents, and the lymph nodes act as filtering beds for the removal of infective and particulate materials. It is probably not an accident that lymphoid cells are found in large numbers at the chief portals of entry into the organism, where the attenuation or removal of, and development of immunity against, invading organisms is of prime importance.

On the basis of these various functions, it seems reasonable to conclude that normal development, growth and proliferation of lymphoid elements serve to make possible the manifestations of the normal functions of these cells. It may also be suggested that acute involution of lymphoid tissue, as a consequence of stress, trauma, or any of the diverse stimuli known to cause lymphoid tissue dissolution either directly or via the pituitary-adrenal cortical mechanism, could release from their imprisonment any infectious or otherwise deleterious agents which may have been trapped in the lymphoid structures. It remains for further experimental work to establish whether this working hypothesis is the basis either for complications of mild infections, which augment pituitary-adrenal cortical secretion, or for the precipitation of symptoms of certain viral diseases following stress. With this concept, it might be possible to account for the

practical experience of lymphoid tissue being at the same time both a defense barrier and a source of potential danger.

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LIII

THE NASAL MUCOSA IN THE LARYNGECTOMIZED PATIENTS

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At birth the nasal mucosa is covered with ciliated columnar epithelium. Various observers in describing the adult nasal mucosa have noted certain areas where microscopic changes have taken place. These areas, called "inactive areas," are found on the anterior tips of the middle and inferior turbinates and the anterior portion of the lateral wall and a corresponding area on the septum.

In these inactive areas the ciliated columnar epithelium is replaced by stratified squamous epithelium. Particles deposited here are removed by traction of the mucous coat covering this area rather than by ciliary activity. It is believed that these inactive areas are produced through traumatism by the inspired air which contains dust and fumes, aided by dryness caused by low humidity. We have all observed these inactive areas in the nasal cavities of our female patients where the face had been freshly powdered before our examination. In these areas the face powder will sometimes remain for one hour.

It is believed that if the humidity of the room is high, the nasal mucosa moist, and the activity of the cilia normal, the danger of a patient contracting an upper respiratory infection is greatly reduced.

Hilding[1] states that "the rate of the mucinous flow varies from the anterior end of the nose, where it is slow, to the posterior portion

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of the nose, where it is rapid. In the active area the speed may equal 10 mm. in one minute, while in the inactive nonciliated areas the speed may be only a few mm. per hour. The entire mucosal surface of the normal nose may be cleaned in from four to ten minutes."

Lucas[2] states that "the length of the cilia bears no relationship to the rate of flow. The greatest speed is obtained on the floor and the least on the roof of the nose."

Proetz[3] makes the rule that "the streaming is more active in the protected recesses of the meatuses than in the exposed portions such as the edges of the turbinates and the septum."

In examining the nasal cavities of laryngectomized patients, it was noted by one of us (J.M.)[15] that certain mucosal changes had taken place. The breathing space remains approximately the same after laryngectomy as before operation, but the mucosal color has changed from a normal pink to a light purple. The color is similar to the light purple of an allergic mucosa, but the bogginess is absent. These findings may also be seen in the tracheotomized patients where the larynx remains but is obstructed and is no longer an airway. This color change is probably circulatory due to lack of stimulation from the air currents.

After laryngectomy the inactive areas previously mentioned are no longer dry, but are uniformly moist. Since the air no longer passes through the nose, few bacteria are deposited on the mucosa and those that do find entrance are soon swept away. On questioning, almost all patients stated that preceding laryngectomy, they had averaged from one to three colds a year, but that since having the operation, they very rarely have a "cold." They experienced no feeling of mucosal congestion in sudden atmospheric changes. Nineteen of the patients believed that the sneezing act was only slightly below normal. This is probably due to sympathetic stimulation.

To study these changes, 30 laryngectomized patients were examined. The ages of these patients at the time of examination varied from 35 to 75 years. The average age was 57 years. Twenty-eight were male and two were female. These patients had been laryngectomized from three months to eleven years. The average time elapsing since operation was three years.

Examination of the nasopharynx showed a moist mucosa. All stated that they did not have a postnasal discharge. Mirror and

cotton tests taken when the patient was breathing, talking and swallowing, showed only a very small amount of air passing through the nose. The sense of smell, according to the patients' testimony, seemed to be almost lost; yet they were able to detect various odors when blown into the nose. When the pharynx was touched with perfumes, and the patient instructed to swallow, he could detect the odors.

Powdered blue chalk placed only on the inactive areas by an ear spoon, appeared in the nasopharynx in 5-18 minutes. The chalk began to move down and backward immediately, giving the impression that these were now active areas. The average time was 9½ minutes. When one considers that these patients were beyond middle age, when secretory powers and ciliary activity are diminished, this would seem to be about normal.

This, in part, corresponds with the findings of Larroudé[4] who reported on five laryngectomized patients who had been operated upon from six months to two years previously. He noted that the inactive areas decreased in size following laryngectomy, gradually changing to active areas. It does not, however, correspond with our findings when he states that "the cilia in the fast zone in two patients operated upon two years previously, gradually lost their activity, requiring thirty minutes for expulsion into the naso-pharynx."

In our series of cases the time required for the chalk to pass from the anterior tip of the turbinate and the anterior portion of the septum to the nasopharynx, seemed to be an individual phenomenon. Several of these patients had been operated upon only three months previously, yet their emptying time was less than four minutes. Three of the patients who had been operated upon eight, nine and eleven years previously, had an emptying time of five, nine and six minutes respectively. Generally, those patients over 70 years of age emptied slowly. Wherever the mucosa was pale and firm, and gave the appearance of dense fibrous tissue, the chalk moved very slowly. Here there was no return to the ciliated columnar epithelium.

The surface temperature of the inferior turbinates tested by the thermocouple varies with the investigator and may depend upon the instrument used. Cone[5] placed the temperature of the inferior turbinate in the normal person at 32° C., while Monti and Gregorini[6] fixed it at 36° to 36.6° C. In determining the surface temperature of the laryngectomized patient, in comparison with the normal, observations were taken using a UMA thermocouple recently calibrated. The metals used in the thermocouple applicator were one of iron and

the other constantan, joined on top by a silver solder lap. The readings were taken on the anterior surface of the inferior turbinate for ten seconds bilaterally. The patient was instructed to open his mouth and not to breathe. One hundred normal patients were tested in this manner. While the oral temperature remained constant, the surface temperature of the inferior turbinate varied in different individuals and with the same individuals on different days. This did not seem to be influenced by humidity or atmospheric temperatures. Our average reading for the normal person was 34° C. In 14 laryngectomized patients, with an oral temperature of 37° C., the surface temperature of the inferior turbinate was 35.2° or 1.2° C. above the normal healthy person. The temperature of the turbinates in the normal persons varied considerably, but in the laryngectomized patients remained fairly constant. This is probably due to the more constant conditions resulting from lack of ventilation in the nose.

When a stream of compressed air, with a temperature of 13° C., was blown for two minutes into the nose of the laryngectomized patients, the mucosa became more pink in color. The surface temperature dropped 5° to 8° C.

We removed specimens of nasal mucosa from the anterior surface of the inferior turbinates on both sides of five presumably normal individuals and 30 laryngectomized patients. The biopsy specimens were fixed in 10% formalin, or in formol-saline, and imbedded slowly at room temperature in celloidin. The sections were stained by a variety of methods for the investigation of the glandular, vascular, and connective tissue elements as well as the epithelium.

Although the boundary line between the stratified squamous epithelium of the vestibule and the typical respiratory epithelium (pseudostratified, ciliated columnar) of the nasal cavity is not a sharp transition, and is often quite variable, most investigators agree that the anterior surface of the middle and inferior turbinates is covered by stratified squamous epithelium. These surfaces are exposed most directly to the incoming air currents (Proetz,[8] Hilding[7]). Oppikofer,[8] found columnar epithelium on the turbinates, without any areas of squamous epithelium in 17.5% of 200 nasal cavities examined. Schall[9] states that the epithelium of the anterior tip and inferior border of the inferior turbinate in the adult may be frequently replaced by a low cuboidal or squamous epithelium. Schieferdecker[10] describes the anterior end of the inferior turbinate as being clothed by squamous epithelium. These reports agree with

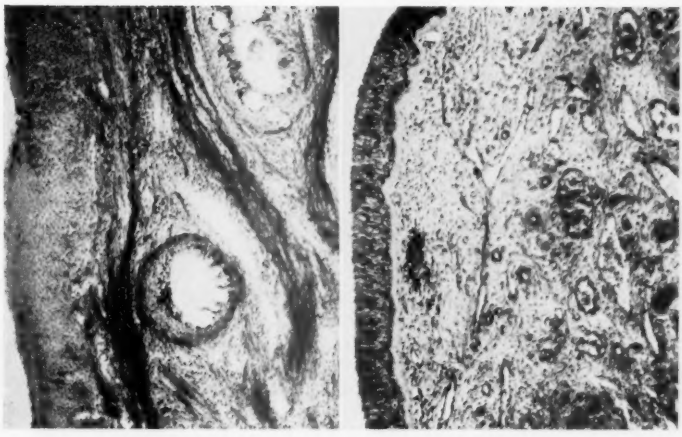

Fig. 1.—Photomicrograph of normal nasal mucosa showing thick bundles of collagenous fibers, and two large ducts from glands deeper in the mucosa; considerable small cell infiltration; stratified squamous epithelium 2 mm. thick. (Mallory's aniline blue connective tissue stain.) (x 100)

Fig. 2.—Photomicrograph of nasal mucosa from laryngectomized patient aged 67, two years postoperatively, showing transitional epithelium, distinct basement membrane, numerous capillaries and veins. (Hematoxylin-eosin stain.) (x 100)

the findings of earlier investigators (Henle, Toldt, Ecker, and Zuckerkandl).

In four of the five control specimens we found only stratified squamous epithelium over the anterior surface of the inferior turbinate. In one specimen there is transitional epithelium and typical ciliated columnar "respiratory" epithelium (Fig. 1 and 5). The squamous epithelium varies greatly, but averages 1-2 mm. in thickness. The stroma is rich in rather dense bundles of collagenous connective tissue fibers, and the glands have large ducts leading to the surface. The subepithelial connective tissue is densely infiltrated by numerous small round cells, mainly lymphocytes and plasma cells. There is an excessive capillary network immediately under the epithelium and, subjacent to this, numerous large muscular veins.

In contrast to the normal, the mucosa of 29 of the 30 laryngectomized patients has a ciliated, pseudostratified columnar epithe-

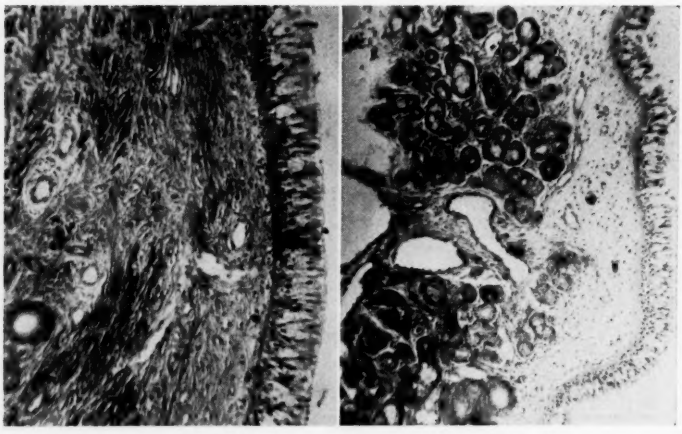

Fig. 3.—Photomicrograph of nasal mucosa from laryngectomized patient aged 38, four years postoperatively, showing numerous mixed glands close to the surface. There is no small cell infiltration in the stroma. Predominance of goblet cells is seen in the epithelium. (Hematoxylin-eosin stain.) (x 100)

Fig. 4.—Photomicrograph of nasal mucosa from laryngectomized patient aged 61, five years postoperatively, showing bundles of collagenous fibers mainly parallel to the surface. (Mallory's stain.) (x 125)

lium, only one specimen having epithelium of the transitional type (Fig. 2). There is very little infiltration of small round cells and the connective tissue stroma is much looser, with no large dense collagenous bundles as in the normal.

The nasal mucosa of the anterior tip of the inferior turbinate after laryngectomy falls into one of three types, the glandular (Fig. 3, 8, and 11), the vascular (Fig. 2, 7, and 9), or the fibrous type (Fig. 4, 6 and 12). In the glandular type there seems to be a proliferation of racemose mixed mucous and serous glands quite close to the epithelial surface, although this change may only be due to a loss of the dense stroma of collagenous fibers.

In the vascular type of mucosa, there are numerous capillaries immediately subjacent to the epithelium, as in the normal, but the large veins or venous sinuses apparently are much closer to the surface. Unlike the deeper veins of the normal mucosa, which have

heavy longitudinal muscle coats, these large superficial veins of the laryngectomized patient (Fig. 7 and 9) have a thin muscle coat.

In the fibrous type of mucosa after laryngectomy, there may occasionally be bundles of collagenous fibers tangential or parallel to the surface (see Fig. 4) but these are never so dense as in the normal. The stroma is made up largely of small bundles of delicate collagenous fibers, not only in the fibrous type but in all the laryngectomized patients. Another finding is the richness of elastic connective tissue. With Verhoeff's hematoxylin stain for elastic fibers, the subepithelial stroma after laryngectomy is found to contain numerous elastic fibers (see Fig. 12), and often a layer of elastic fibers parallel to the surface and just below the basement membrane. In the normal, the elastic fibers are richest around the glandular alveoli, as they have been described (Kubo[11-12]).

We have found some correlation of the histological type of the mucosa with its clinical appearance, the pale or pebbly mucosa tending to be of the fibrous type (Fig. 4), the purple mucosa tending to be of the vascular type with dilated veins (Fig. 7), and the pink to normal colored mucosa tending to be of the glandular type with good vascularity (Fig. 11). There seems, however, to be no correlation which we can discover between the histological structure and age of patient, length of time after laryngectomy, or the ciliary motility. The fibrous, less glandular type of mucosa is found in the older patient, but this is to be expected (Figs. 2, 4, 6, and 12). There seem to be more glands in the younger patients, as is to be expected (Fig. 3, 8, and 11). But the change in the epithelium occurs within three months after laryngectomy (see Fig. 8) and the shortest emptying time was found in one of the oldest patients five years after laryngectomy (see Fig. 7). Neither have we found that the mucous goblet cells predominate over ciliated cells (Proetz) after laryngectomy. Nor can we establish any rule for the thickness and density of the basement membrane, according to Shambaugh's theory,[13] although the basement membrane seems to be most distinct in the older patients (see Fig. 7 and 9).

There is, however, one histological finding which may possibly be correlated with our clinical experience that laryngectomized patients seldom have head colds. In the subepithelial stroma, there is in most of the 57 specimens from 30 patients examined an almost total absence of small cell infiltration, in startling contrast to all the specimens from nonlaryngectomized individuals we have studied.

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Fig. 5.—Photomicrograph of normal nasal mucosa, showing dense infiltration of stroma by lymphocytes, plasma cells, and occasional polymorphonuclear leucocytes with rare eosinophils. The epithelium is 1.5 mm. thick. (Hematoxylin-eosin stain.) (x 155)

Fig. 6.—Photomicrograph of nasal mucosa from laryngectomized patient aged 66, two years postoperatively. Fibrous type of stroma shows individual collagenous fibers. There is very little small cell infiltration. Ciliated cells predominate in the epithelium. (Iron hematoxylin and thiazin red stain.) (x 155)

Fig. 7.—Photomicrograph of nasal mucosa from laryngectomized patient aged 67, five years postoperatively, showing loose stroma, and numerous large dilated veins. (Mallory connective tissue stain.) (x 155)

Fig. 8.—Photomicrograph of nasal mucosa from laryngectomized patient aged 35, three months postoperatively, showing glandular type of mucosa; low epithelium, with cuboidal cells in some areas, but mainly ciliated. (Hematoxylin-eosin stain.) (x 155)

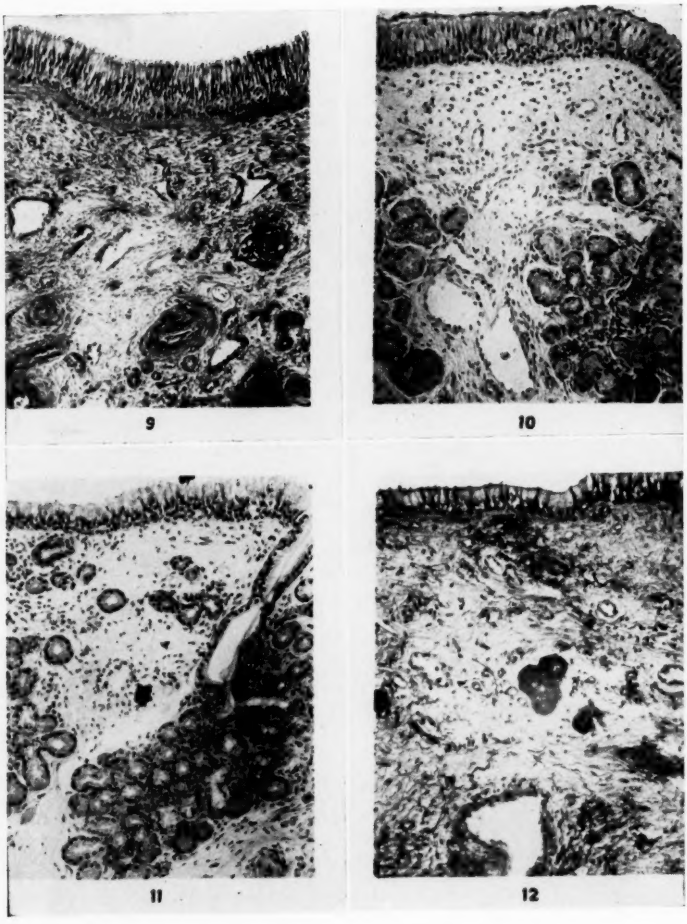

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Fig. 9.—Photomicrograph of nasal mucosa from laryngectomized patient aged 67, two years postoperatively. The epithelium has almost no mucous cells, consisting almost entirely of tall, columnar ciliated cells. The basement membrane is very distinct. Some small cell infiltration is seen. (Hematoxylin-eosin stain.) (x 155)

Fig. 10.—Photomicrograph of nasal mucosa from laryngectomized patient aged 38, four years postoperatively, showing distinct mucous blanket on tips of cilia and practically no small cell infiltration. (Hematoxylin-eosin stain.) (x 155)

Fig. 11.—Photomicrograph of nasal mucosa from laryngectomized patient aged 46, one and a half years postoperatively, showing glandular type of mucosa. Mucous cells predominate in the epithelium. There is no small cell infiltration. (Hematoxylin-eosin stain.) (x 155)

Fig. 12.—Photomicrograph of nasal mucosa from laryngectomized patient aged 74, two years postoperatively, showing elastic connective tissue fibers. The small, slender, twisted black threads throughout the stroma are elastic fibers. (Verhoeff's hematoxylin stain.) (x 155)

Sternberg,[14] who studied histologically the nasal mucosa postmortem of seven patients with total extirpation of the larynx, also reported that the lymphoid elements of the mucosa diminish. He stated that the longer the period of time which had elapsed after laryngectomy, the fewer leukocytes, lymphocytes, mast cells, and other wandering cells were to be found. In our investigation, these infiltrated elements disappear to a large extent within the first year after laryngectomy.

Sternberg[14] also stated that the lymphocytes and plasma cells which are normally present in and around the alveoli of the subepithelial glands disappear after laryngectomy. Our findings agree completely with this statement (see Fig. 3 and 11).

We cannot, however, agree with Sternberg's conclusion that the nasal mucosa has a diminished vascularity after laryngectomy, the small vessels gradually acquiring a constricted lumen. Perhaps the difference in our studies is that Sternberg studied only postmortem specimens from patients who had died from recurrence of carcinoma, whereas we studied biopsy specimens removed without anesthesia or vasoconstriction.

We have commented above that although goblet cells are numerous in the surface epithelium, they do not predominate in most cases over the ciliated cells, as contrasted with Sternberg's report. We do agree, however, with his conclusion that the crescents of Giannuzzi apparently increase in number in the mixed racemose glands of the stroma (see Fig. 3 and 8). Clinically, the mucosa of most patients was quite moist, with a good mucous blanket, and this finding is confirmed by the histological picture of adequate glandular development, with active secretion microscopically.

SUMMARY

1. In the laryngectomized patients the inactive areas gradually become active, the squamous epithelium is replaced by ciliated columnar epithelium and is always moist.

2. The emptying time from the anterior end of the turbinates to the nasopharynx is accelerated. Microscopically, the mucosa is well ciliated, has good glandular activity and a good blood supply.

3. The color change is from a pink to a pale purple.

4. The patients are subject to infrequent colds. Microscopically, there is little or no small cell infiltration.

5. The average surface temperature of the turbinates is higher and more uniform than normal.

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LIV

CONTACT ULCER GRANULOMA

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Contact ulcer granuloma of the larynx presents an interesting diagnostic problem, particularly to those who have not seen a great deal of laryngeal pathology. However, to the trained laryngologist it presents a typical picture that will rarely be confused with other types of diseases.

In the period from 1937 through 1946, 53 patients with contact ulcer granuloma of the larynx were examined in the Section on Laryngology, Oral and Plastic Surgery of the Mayo Clinic. We are briefly reviewing the literature and recording our experience in treating these patients.

Contact ulcer of the larynx was first defined in 1928 by Jackson[1] in this manner: "Contact ulcer of the larynx is the name I have given to superficial ulceration on one or both sides of the larynx posteriorly, the ulcerated surface coming in contact on phonation with that of its fellow on the opposite side, the latter being ulcerated or not, according to whether the ulcer is monolateral or bilateral."

When viewed with the laryngeal mirror the ulcer is seen partly on edge (Fig. 1) in the region of the vocal process. One may actually see a tiny cuplike depression on one side (Fig. 2) in which the vocal process of the opposite side rests on phonation. More often, though, the actual ulcer is not seen because of the exuberant granulation tissue present (Fig. 3). For this reason we prefer the term "contact ulcer granuloma" (Fig. 4).

Pathology. The pathology of the condition is one of chronic nonspecific inflammation. One may find polypoid masses composed

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Fig. 1.—Unilateral contact ulcer granuloma. Only the edge of the granuloma is visible.

Fig. 2.—Bilateral contact ulcer granulomas. Note the cupping of the granulomas.

Fig. 3.—Unilateral contact ulcer granuloma. Note the mammillated appearance.

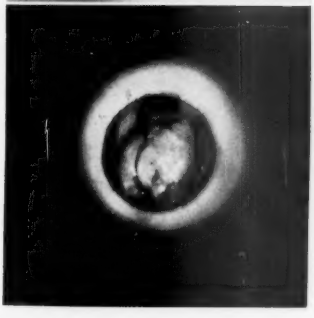

Fig. 4.—Bilateral contact ulcer granulomas with vocal cords attempting to approximate.

of new granulation tissue richly supplied with blood vessels and covered with inflammatory exudate (Fig. 5). On the other hand there may be small, hard, fibrous nodules composed of inflammatory fibrous tissue with few blood vessels, the whole covered with epithelium (Fig. 6). The cartilage of the vocal process may be surrounded by the granulation tissue (Fig. 7) or found in the floor of the ulcer. Loose cartilage may be free in the granuloma.

Symptoms and Etiology. The patient complains of discomfort in the larynx, hoarseness which may be slight, or pain extending to the ear, and sometimes hemoptysis and chronic cough.

Vocal abuse is the chief etiologic factor in the production of a contact ulcer granuloma. The mechanical hammering of one vocal process against another apparently causes ulceration of the mucous membrane over the vocal process. In those instances in which contact ulcer granuloma follows tracheal intubation the chief etiologic factor is also a mechanical one. In all probability the intratracheal tube produces an ulcer in the larynx either by pressure necrosis or by trauma.

Tracheal intubation for general anesthesia was introduced by Elsberg[2] in 1910. For many years, few physicians, if any, were aware that this procedure could in some instances be followed by contact ulcer granuloma. Clausen[3] in 1932 was the first to report a case of contact ulcer granuloma following intubation. We have been able to find eight additional cases[4-10] in the English and American literature (up to March, 1947) which, with the nine cases of our own, makes a total of 18 cases.

Fig. 5.—Contact ulcer granuloma. Note the blood vessels and exudate.

Fig. 6.—Epithelized contact ulcer granuloma with fibrosis.

Fig. 7.—Contact ulcer granuloma. Note the necrotic cartilage.

Treatment. Most writers in general have recommended a plan of treatment which consists of surgical excision of the granuloma and removal of part of the vocal process if it is exposed, prohibition of irritant medication or swabbing, and absolute silence. Most authors agree that ultimate recovery takes place as a rule, but progress has been slow in most instances and repeated excisions are often necessary.

Some[11] have expressed the belief that cauterization of the bed of the ulcer is bad because of the superficial character of the lesion and the proximity of the crico-arytenoid joint. On the other hand, in 1938 Howard[12] used fulguration for contact ulcer granuloma with excellent results. In his opinion fulguration definitely hastened recovery. Surgical diathermy has been used for practically all of the patients treated at the clinic for the last ten years and no ill effects have been noted.

In our practice the hypopharynx and larynx are cocainized with 10% solution of cocaine and the patient is anesthetized with intravenously administered thiopental sodium (pentothal sodium), supplemented by curare (d-tubocurarine chloride). Suspension laryngoscopy is used to expose the larynx. The granuloma is removed with cup forceps and the base of the wound is touched with surgical diathermy.

After a few days the patient is sent home on a regimen of absolute silence with instructions to return in one month for examination. At the end of the month if the granuloma has not recurred or is definitely smaller we continue with observation at periodic intervals. On the other hand it may be necessary to repeat the removal of the granuloma.

It is important to wait at least one month or longer between operations. In this way the ulcer gets a chance to heal without being stimulated by repeated intervention.

We noticed that if the throat symptoms had been present for months or years rather than weeks, there was more chance of getting the patient well with only one operation. There are exceptions to this, particularly if the granuloma has been stimulated by silver nitrate or recent biopsy. Then, too, it is difficult to determine from the history how long the granuloma has been present.

Often at the time of removal of the contact ulcer granuloma one can judge fairly accurately whether or not there will be recur-

rence. If the granuloma bleeds readily when touched or is soft and friable when grasped with the cup forceps, there is less chance of getting the patient well with only one operation than if the granuloma is hard and fibrosed.

Woodruff[13] in 1936 explained the high incidence of this disease in men on the basis of the fact that the raspy or throaty method of voice production is seldom used by women. Peacher and Holinger[14] carried this observation to its logical conclusion and cured some contact ulcer granulomas by vocal re-education of the patients with apparently better results than they were able to obtain by surgical excision of the ulcer and absolute silence.

Excision of the contact ulcer granuloma followed by surgical diathermy in conjunction with vocal re-education seems to us to be the ideal method of treatment. Excision affords a means of obtaining a biopsy specimen. In this way the clinical impression of contact ulcer granuloma can be verified by microscopic examination of tissue removed. In three instances during the period from 1937 through 1946, microscopic examination of tissue removed from the larynx showed the clinical impression of contact ulcer granuloma to be wrong. In one case the pathologic diagnosis was myxomatous tissue, in another it was squamous cell epithelioma, grade 2 (Broders' method), and in a third the diagnosis was hemangio-endothelioma imitating hypernephroma.

TABLE 1

CONTACT ULCER GRANULOMA

Indeterminate etiology	44
After intratracheal anesthesia	9
Total	53

Analysis of Data. Fifty-three patients with contact ulcer granuloma were examined in the period from 1937 through 1946. We have divided these cases into two groups depending on whether or not there was any previous history of tracheal intubation. In 44 patients we could find no history of previous tracheal intubation. A much smaller group of 9 patients gave a history of tracheal intubation prior to the onset of their symptoms (Table 1).

Symptoms are similar in the two groups and the gross and microscopic appearances are identical. There are some striking differ-

ences however. The contact ulcer granuloma which follows tracheal intubation occurs more often in women than in men (Table 2). We found the ratio of women to men to be 2:1 in our series. In the cases reported in the literature up to March, 1947, the ratio of women to men was 3.5:1. This is in marked contrast with the group in which there has been no history of tracheal intubation. In the latter group the ratio of women to men reported in the literature is about 1:99. We found that all of our patients in this group were men.

TABLE 2

CONTACT ULCER GRANULOMA

SEX INCIDENCE

	M	F
Indeterminate etiology	44	0
After intratracheal anesthesia	3	6
Total	47	6

The contact ulcer granuloma which follows tracheal intubation is more frequent in women than in men, probably because women have a smaller larynx than men. It is doubtful whether length or kind of operation, the route or difficulty of introduction of the tube have anything to do with it. By analyzing our cases and those reported we found that the tube had been introduced through the nose in 10 cases and through the mouth in 8 cases. We found 5 cases in which the lesion followed difficult introduction and 7 cases in which there was no difficulty; in 6 cases this information could not be obtained. The average length of the operation was 127 minutes. The shortest was 37 minutes and the longest was 300 minutes.

The contact ulcer granuloma which follows tracheal intubation is more often bilateral than unilateral, occurring in 7 of our 9 cases (Table 3). The frequency of occurrence of bilateral granulomas in those patients not having had tracheal intubation was only 5 of a total of 44.

Kearney[8] in 1946 said that the benefits of intratracheal anesthesia greatly outweigh its few undersirable sequelae. We agree, and intend to continue using intratracheal anesthesia, realizing that even in the hands of the expert anesthesiologist tracheal intubation can be followed by contact ulcer granuloma. Surgeons should be aware of this fact and if any of their patients, particularly women, com-

plain of hoarseness, pain in the larynx, loss of voice or a choky feeling after tracheal intubation they should see to it that the larynx is examined. Contact ulcer granuloma as a sequela of intratracheal anesthesia is probably not as rare as the few reported cases would lead one to believe.

TABLE 3

CONTACT ULCER GRANULOMA

LOCATION

	Bilateral	Unilateral
Indeterminate etiology	5	39
After intratracheal anesthesia	7	2
Total	12	41

In the group of 44 patients who had no history of tracheal intubation there were 7 who did not receive surgical treatment at the clinic. These patients did not receive treatment for reasons of poor general health, advanced age, small size of the lesion or refusal to have treatment. We were able to follow by letter and personal examination by the patient's physician or at the clinic 30 of the 37 patients treated in this group. In 23 of these the condition was cured with treatment (Table 4).

TABLE 4

CONTACT ULCER GRANULOMA

TREATMENT

	Treated	Traced	Well
Indeterminate etiology	37	30	23
After intratracheal anesthesia	9	9	9
Total	46	39	32

It is of some interest to know how many operations were necessary to get these 23 patients well (Table 5). We found that 8 patients had only one operation, 11 had two operations, 3 had three, and 1 required five operations.

TABLE 5

CONTACT ULCER GRANULOMA

INDETERMINATE ETIOLOGY

NUMBER OF OPERATIONS

PATIENTS WELL

8 patients	had	1 operation each
11 patients	had	2 operations each
3 patients	had	3 operations each
1 patient	had	5 operations
23 patients	had	44 operations

All 9 patients with a history of tracheal intubation received surgical treatment at the clinic for the contact ulcer granuloma. All were cured with treatment. We found that 4 patients were cured with one operation, 4 with two operations, and 1 with three (Table 6).

TABLE 6

CONTACT ULCER GRANULOMA

AFTER INTRATRACHEAL ANESTHESIA

NUMBER OF OPERATIONS

PATIENTS WELL

4 patients	had	1 operation each
4 patients	had	2 operations each
1 patient	had	3 operations
9 patients	had	15 operations

Of the 30 patients with no history of intubation whom we were able to follow, 7 were not cured by the treatment received at the clinic for their contact ulcer granuloma (Table 7). Four had only one operation and of these 3 did not return; one was a physician in active practice. A second operation was not recommended. Of the 3 remaining, 1 patient had two operations, another had three, and 1 had five operations without relief. The last 2 patients were ministers.

TABLE 7

CONTACT ULCER GRANULOMA

INDETERMINATE ETIOLOGY

NUMBER OF OPERATIONS

PATIENTS NOT WELL

4 patients	had	1 operation each
1 patient	had	2 operations
1 patient	had	3 operations
1 patient	had	5 operations
7 patients	had	14 operations

Physicians, farmers, managers, ministers, agents, and salesmen are those who are most likely to get a contact ulcer granuloma (Table 8). It seems to us too that these patients are of the "nervous" type or live on a plane of high nervous tension. The trip to the seashore that used to be recommended for contact ulcer granuloma may have been beneficial not so much because of the sea air which the patients breathed but because of the rest and relaxation which they found there.

TABLE 8

CONTACT ULCER GRANULOMA

INDETERMINATE ETIOLOGY

OCCUPATION

Occupation	Patients	Occupation	Patients
Physicians	6	Singer	1
Farmers	5	Plumber	1
Managers	5	Carpenter	1
Ministers	4	Laborer	1
Agents	3	Merchant	1
Salesmen	2	Bank clerk	1
Office workers	2	Credit man	1
Miner	1	Miscellaneous	9
Total			44

SUMMARY

With the method we have employed in the treatment of contact ulcer granulomas we have been able to cure 32 of the 39 traced patients. In 23 of these 32 cases the lesion was of indeterminate etiology and in 9 the patients had undergone intratracheal anesthesia. Since the report of Peacher and Holinger[14] we are adding voice education to the treatment, hoping to get still better results.

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LV

BONY STENOSIS OF THE LARYNX

REPORT OF A CASE

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Bony stenosis of the infant larynx is rare enough to warrant report of a case in a two-year-old child, who has now been under my care and observation for 16 years. At my first contact with the patient she seemed to present a typical case of severe laryngotracheobronchitis, with slight chance of recovery. At that time, 1933, modern chemo- and antibiotic therapy had hardly started. No similar case has come to my attention in the meantime. The unusual reaction in the larynx, resulting in complete closure, first by edema, then by laryngeal polypi, and finally by well formed osseous tissue, makes the case unique as far I can learn from my colleagues in otolaryngology and pathology.

J. J. M., aged 16½ months, was admitted to the pediatric service in the Isolation Ward of the New Haven Hospital on September 8, 1933. Her chief complaint was choking as the result of a week of acute upper respiratory infection. Dyspnea had been present for two days and because it was gradually progressing, hospitalization was advised.

Physical examination revealed an acutely and gravely ill child with marked respiratory distress, no cyanosis and no disease except in the nose, throat and larynx and chest. Examination of the throat and nose showed swelling of the mucous membrane and excessive, thick, tenacious secretion in the oropharynx. Direct laryngeal examination showed the mucosa to be acutely inflamed with thick mucopus in the pyriform sinuses. The larynx was markedly obstructed by swelling of the mucous membrane so that there was a very small aperture

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Read before the meeting of the American Laryngological Association, New York City, May 16-17, 1949.

through which the patient was then breathing. It was thought that the child could continue for a short time without relief so she was watched for several hours. Temperature was 39.8° C., respiratory rate, 34. Because of diphtheria as a possible diagnosis she was given 60,000 units of diphtheria antitoxin. A few hours after admission respirations became much more labored and it was obvious that an improvement in the airway was mandatory.

The question of a decision between a tracheotomy and intubation was discussed by the pediatric and otolaryngologic staffs. Previous experience with tracheotomies induced the pediatricians to make an urgent request for intubation rather than tracheotomy. To the otolaryngologic staff, the patient seemed so desperately ill that great pessimism was expressed about her eventual recovery with any sort of mechanical relief of her respiratory distress. Because of possible damage to the laryngeal mucosa, tracheotomy seemed the procedure of choice by the otolaryngologic staff but because of the urgent pleas of consultants, intubation was done approximately seven hours after admission.

Reports of the laboratory tests were as follows: The patient was Schick-negative; blood serology by the Kahn method was negative; from the nose and throat, bacteriologic cultures produced staphylococci and mucosus catarrhalis. There were no Corynebacterium diphtheriae from either nose or throat; blood count was within range of normal with only 5,300 white cells per cmm.; the urine was negative. A culture taken from the larynx by means of swab showed hemolytic staphylococcus, Streptococcus haemolyticus, diphtheroids and pneumococci type 6B. Blood culture showed no growth; blood count on the following day showed 6,800 white cells per cmm. on one count and 10,900 on another; tracheal culture obtained later showed staphylococci and Haemophilus influenzae.

The diagnosis was acute influenzal laryngotracheobronchitis. For the first three days following admission, after the intubation tube had been placed, the patient was given supportive therapy consisting of blood transfusions, intravenous glucose and saline hypodermocylses. Her airway was satisfactory for approximately three days, when increased edema in the airway began to decrease the available respiratory lumen. Direct examination at this time showed that the edema was at the level of the epiglottis *above* the intubation tube.

On the evening of the third day, following an infusion, the patient had a violent spell of coughing and the intubation tube was

dislodged. Immediate laryngoscopy revealed no evidence of a membrane but the edema had markedly increased in the hypopharynx. Attempt to introduce a larger intubation tube was unsuccessful and a tracheotomy was performed after the intubation had been in place for three days. This afforded immediate relief and the child from then on was able to tolerate a tracheal tube without difficulty. Further supportive treatment was administered by the pediatric service and the patient gradually recovered from the severe infection, which seemed to be overwhelming at the time of her admission.

During the next two months, ten attempts were made to remove the tracheal tube but the patient could not tolerate breathing through the larynx. The possibility of severe infection in the adenoids and tonsils induced us to remove them in an attempt to eliminate a possible focus of infection. This was done six weeks after admission.

On November 22, 1933, three months after the child was admitted, the larynx was examined and found filled with a papillomatous mass. This was removed and microscopic examination showed it to consist of a typical laryngeal polyp with acute and chronic inflammatory reaction (Fig. 1 and 2).

Microscopic Examination: "Preparation is covered by a layer of stratified squamous epithelium which is fairly well preserved. The keratinizing layer is for the most part missing. The spinous layer is broad and fairly well preserved and composed of loosely arranged ovoid cells with centrally placed well staining nuclei. The germinal layer is intact. The rete pegs are short and blunt. The subjacent tissue contains old and recent granulation tissue with many thin walled blood vessels which are engorged and an exudate of polymorphonuclear leucocytes and large and small mononuclear cells. In some places some poorly preserved mucous glands are seen." (Halpert)

During the following seven months while the child remained in the hospital, many unsuccessful attempts were made to remove the tracheal tube. The larynx was dilated from above and from below but at no time was there a large enough aperture through the laryngeal structure to permit even quiet respiration without ensuing severe cyanosis. It was thought that possibly too much attention was given to the location of the lesion so that a period of strict rest was advised.

On June 11, 1934, nine months after the original admission, direct laryngeal examination showed that there was no opening

through the larynx, not even enough to permit the passage of a small bougie. It seemed necessary then to do a thyroidotomy and examine the interior of the larynx to discover the exact nature of the obstructing mass.

I quote from my operative notes: "The cricoid cartilage was apparently normal; however the stenosis was between the level of the cricoid cartilage and the vocal cords. This stenosis consisted of a hard mass and upon further investigation it turned out to be either proliferation of the cartilage or actual bone formation." This piece of bone was removed with a small mastoid rongeur. A blunt ended suction tube was passed down through the larynx and this was used as a guide to assist in the carving out of the obstruction in the region of the stenosis. After the laryngeal aperture was large enough a "silver permanent dilating tube was placed, this was fitted on the upper end of a tracheal tube through which the patient breathed." The bleeding was annoying and it was hoped that epithelialization of the larynx would take place around the silver tube passing through the stenosis (Fig. 3 and 4).

Following is the pathologist's report of the tissue removed at operation:

Gross Examination: "The specimen consists of an osseous fragment of tissue which is roughly disk shaped, measuring 3 mm. in thickness and 5 mm. in diameter."

Microscopic Examination: "The preparation consists of a small fragment of osseous tissue with well formed haversian systems and narrow spaces." (Tennant)

For the next four months the larynx was kept under observation. A continuous tube was in place through the previously stenotic region. There seemed to be some irritation from the silver tube so that it was replaced by a piece of rubber tubing attached to the lower end of the tracheal tube.

On May 17, 1935, 20 months after the original admission of the patient, the tube through the stenosis was finally removed. It was hoped by this time that the child's larynx had grown enough so that it would remain open for satisfactory laryngeal breathing.

The patient was discharged from the hospital on May 28, 1935, 20 months and 20 days after she was first admitted.

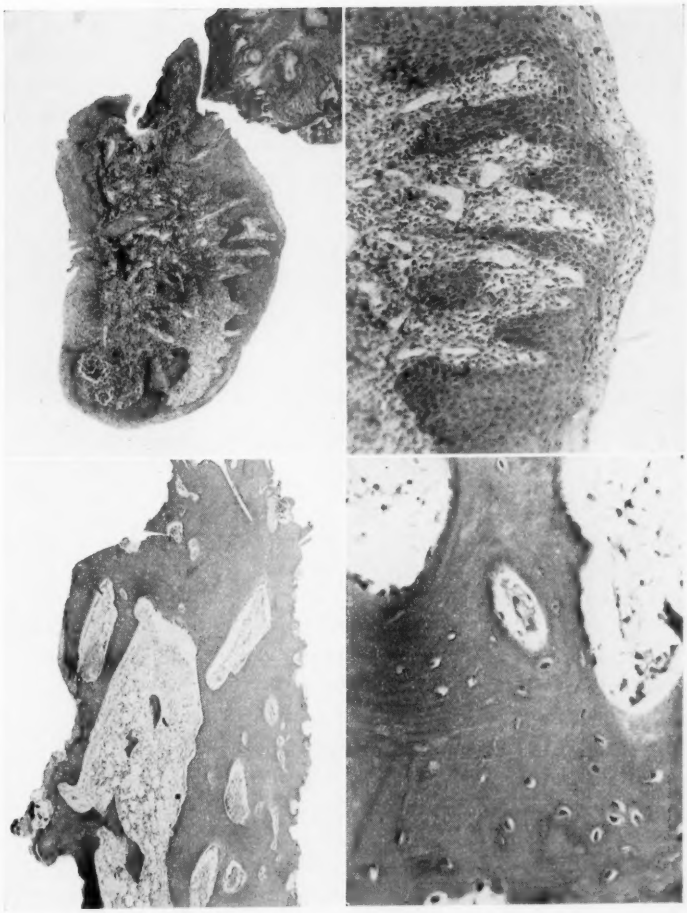

Fig. 1.—Photomicrograph of laryngeal polyp.

Fig. 2.—Photomicrograph of laryngeal polyp (high power).

Fig. 3.—Photomicrograph of bone removed at the level of the stenosis.

Fig. 4.—Photomicrograph of bone removed at the level of the stenosis (high power).

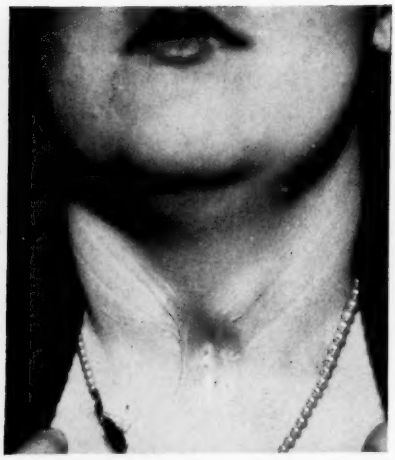

Fig. 5.—Resulting scar 16 years after first tracheotomy.

Since that time it has not been necessary to replace a dilating tube through the larynx. In the intervening years, however, the larynx has been examined and dilated on eight or ten occasions. In October, 1935, the patient had pneumococcal bronchial pneumonia at which time the scar in the anterior portion of the neck opened and gave her a safety breathing passageway.

The child has developed normally otherwise, her voice has been very hoarse and she has never had a wide open larynx. During her school years, it was necessary to curtail her excessive activities and she has considered the possibility of a plastic operation on her anterior neck to improve the condition of the scar. Choice between this and an opportunity to be married resulted in the latter, and on October 14, 1948, at the age of 18, she produced a normal male child.

Her voice is entirely understandable and the wound on the anterior portion of the neck is as indicated in the accompanying photograph (Fig. 5).

(The following is what the patient said and reproduced with the wire recorder used at the time of the presentation of the paper.)

"My name is J.J.D.M. and for many years I have had trouble with my larynx. [pause] It started when I was a small child of two years, [pause] and has been a source of concern to me since that time. [pause] However, I have grown up now [pause] and have a fine 7-month-old baby. [pause] My voice is [pause] hoarse but I get along all right." (The pauses noted in the above recitation were where the patient breathed during the short speech.)

The patient's voice as recorded on May 14th, 1949 was presented with a Webster Wire Recorder.

It is interesting to note that at the beginning of her speech she is able to emit many more words during each expiration than she can toward the end. She becomes air-hungry quickly due to the constriction at the level of the larynx. It is also noted that there is an audible wheeze during inspiration. This is always present except during the times of the least necessary oxygen requirements.

SUMMARY

A case of bony stenosis of the larynx in a 2-year-old child, following acute influenzal laryngotracheobronchitis and laryngeal intubation, is presented. The final outcome resulting in an adequate airway for quiet breathing is satisfactory; when more air is required the remaining laryngeal stricture causes an audible wheeze. The voice is markedly impaired.

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LVI

LARYNGEAL STENOSIS

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Any good textbook on otolaryngology will list all the known causes of the condition we call stenosis of the larynx, which is a narrowing of the cavity of the larynx interfering with the passage of air. For the purpose of this paper a discussion of all the causes and their treatment is impossible; therefore, it shall be limited to laryngeal stenosis following diphtheria, tuberculosis, indwelling endotracheal tubes, indwelling tubes in the esophagus either for feeding or decompression, and accidental crushing of the larynx.

My years of service as Head of the Departments of Otolaryngology in the Herman Kiefer Hospital, Detroit's contagious hospital, in Harper Hospital, a private institution, and in the Receiving Hospital of the City of Detroit, closely affiliated with Wayne University Medical School, have afforded the background for these observations. Fully appreciating that many of you have had more experience with laryngeal stenosis in its various forms than I have, to your knowledge let me add some of my findings that I hope may prove helpful in making the road a little easier for both the patient and the surgeon.

Most of the mild forms of laryngeal stenosis can be relieved by dilatation with varying forms of bouginage. But the severe types seen as a sequel of automobile and airplane accidents with destruction of the entire laryngeal box may bring the most difficult problem seen in all surgery. Then, too, one must not be too sanguine about some of the less severe appearing contractions, for if the mesoderm is in control of the developmental and healing processes of the body giving marked scar formation, difficulties may mount to tax all your ingenuity. We see this situation following tonsillectomy, and I have often said that the healing process that scars and contracts the tissues of the throat following tonsillectomy heals the hernia.

Read before the meeting of the American Laryngological Association, New York City, May 16-17, 1949.

Diphtheria is the most frequent cause of acute laryngeal stenosis, and in its treatment, intubation or tracheotomy, or both, play the chief role. In the contagious hospital of the City of Detroit previous to World War II, intubation was the first procedure in laryngeal diphtheria with obstruction. In the past several years, tracheotomy has always been performed, and whenever possible this has been preceded by intubation which permits a thoughtful and less hurried tracheotomy. The incompleteness of the records previous to 1927 would not permit a fair appraisal. Therefore I shall present the result of this institution, Herman Kiefer Hospital, for the 21-year period from 1927 to 1947, inclusive.

21-YEAR STUDY OF DIPHTHERIA CASES, 1927 THROUGH 1947

	END RESULTS OF CASES TREATED ON THE SERVICE FOR DIPHTHERIA PATIENTS		
	CASES	DEATHS	FATALITY %
Total diphtheria cases (all types)	8382	842	10.0%
Of the above cases 1073 or 12.8% were the laryngeal form.	1073	211	19.7%
Of the total laryngeal cases 466 or 43.4% were intubated.	466	75	16.1%
Of the total laryngeal cases 59 or 5.5% were tracheotomized but not intubated.	59	30	50.8%
Of the total laryngeal cases 78 or 7.3% were intubated and tracheotomized.	78	38	48.7%
Of the total laryngeal cases 470 or 43.8% were neither intubated nor tracheotomized.	470	68	14.5%

Of all cases of laryngeal diphtheria in which intubation or tracheotomy was performed during this 21-year period, only one case resulted in permanent laryngeal stenosis, a rate of 0.17%.

Out of this entire group there was but one case of chronic laryngeal stenosis, and this was cured in a two-month period at the University of Michigan Hospital with a two-way tracheotomy tube, under Dr. Furstenberg's care. I feel this is a most enviable record, particularly in view of the fact that our lake region produces virulent infections with severe pathological change. My observations convince me that the basis for this almost perfect record is due to the establishment of a call-bell system which summoned any one of a battery of young men consisting of Doctors Donald Young, John Gordon, and Franklin H. Topp with Dr. Benjamin Bernbaum acting as pediatrician through most of this period. The first three, who were in constant service in the institution were all excellent intubationists. Intubation is an art developed only by repetition. The perfection of this art cannot be accomplished today for there are not enough cases to train one's hand. We are therefore seeing another step in the evolution of medicine.

With the advent of good suction, chemotherapy, and antibiotics, and the dwindling supply of expert intubationists, tracheotomy is now the method of choice. Emphasis, therefore, should be placed on a low tracheotomy, properly done, and done sufficiently early so that laryngeal stenosis may not come as a complication.

I have seen cases of panic and spasmodic stenosis in young children. Panic stenosis, an excellent name for it, was relieved when someone conceived the idea of putting a nail through a cork and tying it around the child's neck. This seemed to give him perfect confidence when he put his hand up and felt the cork and tape. A special intubation tube, such as a "non-cough-up tube" or the tube with a long anteroposterior lumen and a narrow neck suggested for spasmodic stenosis, has never been used. Panic and spasmodic stenosis are akin in their development and treatment.

Since at present laryngeal diphtheria is less frequently seen, we are likely to forget that it exists. Let us ever keep in mind that laryngeal obstruction may be laryngeal diphtheria and if undiagnosed is associated with a high mortality. Several experiences in the past year have brought this clearly to my mind.

We have had our difficulties, too. A child aged 1½ years entered Herman Kiefer Hospital with a history of whooping cough severe enough to demand immediate tracheotomy. A hurried tracheotomy was done, but the child did not do well. A radiographic

Fig. 1.—Foreign body in larynx.

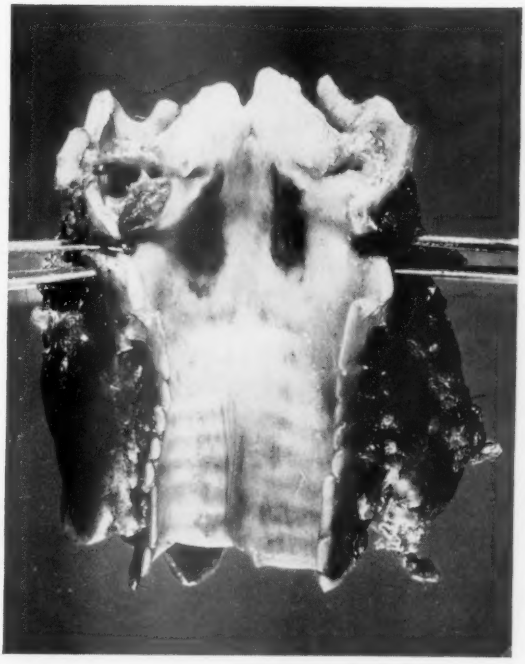

Fig. 2.

study of the chest showed pneumothorax of the right lung, areas of consolidation of both lungs, and cervical emphysema. I was called, and a laryngoscopic examination showed an unclean larynx with granulation tissue, mucopus, and edema which I felt at the time was an acute laryngotracheobronchitis. A bronchoscopy was done through the tracheotomy wound, the easy access to the lung, and suction applied. This relieved most of the lung symptoms. When a more complete history was obtained, a peanut episode three weeks before was revealed and further bronchoscopy was decided upon. Unfortunately the tracheotomy tube became blocked and the patient expired. Upon postmortem examination a half a peanut was found in the ventricle of the larynx (Fig. 1). There is only one consolation in the whole episode and that is the pathologist's report: "The material found has the appearance of a half a peanut. It is embedded in loose granulation-like tissue and the surrounding laryngeal tissues are markedly swollen. It is not visible from above or below, and is seen only on opening the larynx."

Now I habitually look for a half a peanut in the ventricle of every larynx I examine, and probably will never find one again. Chevalier Jackson's aphorism is most applicable: "Cry over spilled milk enough to memorize how you spilled it."

I have tracheotomized only three tuberculous patients throughout the years. The immediate result in relieving the dyspnea was good, but the soft, succulent, avascular tissue of these patients does not heal well, and in the final analysis little was accomplished. In my experience, if tuberculous larynges heal, they scar with the vocal cords apart and the cavity of the larynx not stenosed, at least in the greater percentage of cases. In this situation, of course, there is a permanent hoarseness. With the advent of streptomycin most cases of laryngeal tuberculosis heal well and apparently permanently providing the lung condition heals so that the larynx is not re-infected.

Another step in the evolution of medicine has been the use of endotracheal tubes in anesthesia. To me this has been a great advance in anesthesiology, particularly in long operative procedures. But in its wake, as is true with every advance, come some complications. It has been my experience to have had several cases of permanent damage to the larynx from indwelling endotracheal tubes. One case was that of a young woman 19 years of age, physically well—a case of severe barbiturate poisoning in which a rubber nasal endotracheal tube had been left in place for 30 hours. This was

Fig. 3.—Photomicrograph showing indolent ulceration.

followed by an oral endotracheal tube for 14 hours. As a sequel of this, there was permanent damage to the vocal cords with almost complete destruction of the left cord and considerable damage to the right. In the final healing there was some stenosis, a web formation in the anterior commissure, and permanent hoarseness. A second case was that of a girl of similar age, physically well until she developed an aneurysm of the circle of Willis with hemorrhage into the brain stem and interference with the respiratory center so severe that she was put in a respirator. An oral endotracheal tube was inserted for 26 hours. It was removed and re-inserted, remaining until the patient's death nine hours later.

Figure 2 is a photograph of the larynx and Fig. 3 shows the indolent ulceration in this case.

Since such cases finally come to the attention of the otolaryngologist he should reach some conclusion as to the length of time indwelling endotracheal tubes should remain before a tracheotomy is considered.

An endotracheal tube may remain for a period of six hours in long operative procedures, and sometimes a bit longer, without any apparent damage—at least no complaint and no hoarseness. The problem, therefore, is how long an indwelling endotracheal tube should remain in place, how large it should be, and of what material? In discussion with Dr. Ivan Taylor, Professor of Anesthesiology of Wayne University Medical School, the conclusion was reached that an endotracheal tube should be removed, cleansed, and oiled, and the larynx examined at least every ten hours. The tube must be large enough to maintain a good airway in a severe anoxic patient. Otherwise, it is not performing its complete function. A No. 32 or No. 34 French catheter is the preferred size for the adult. There is no unanimity of opinion yet whether a plastic tube is better than a rubber one. The plastic tube is inclined to be a little hard and produces in some people an allergic response.

The indwelling esophageal tubes of the Miller-Abbott type next deserve our consideration. Literature provides a sufficient number of cases of chronic laryngeal stenosis following the use of indwelling esophageal tubes to warn us of the dangers of this practice. I have had two patients of this type. One of these had an indwelling esophageal tube left in for a period of two weeks. It was removed at the end of one week and replaced. As a sequel of this, perichondritis of the cricoid cartilage developed with a complete stenosis of her larynx. A thyrotomy was done and an airfoam rubber mold was sutured into the larynx with skin graft covering. The patient developed a most intense inflammation of the larynx and neck. The mold was removed and a hard rubber mold inserted which did not prove satisfactory. The patient has refused operative procedure of any kind since this experience and wears a tracheotomy tube. Again the problem presents as to how long should these tubes remain indwelling before a gastrostomy or jejunostomy is done? Each case must stand on its own merit but certainly one week should be the maximum in most of them. Of what size should they be? And of what material? The trend of thinking at present is that a tube approximating a No. 18 French catheter, made of rubber is the choice; however, plastic tubes are having some supporters and this group probably will increase in number as the plastic tube is perfected to the point where the danger of an allergic response has been eliminated.

Because of this experience with airfoam rubber I began searching for a very inert substance as a mold in cases of skin grafting in chronic laryngeal stenosis.

Experiment No. 1: Swedish cellulose was implanted in the larynges of two dogs. The result was that both dogs died within seven to nine days postoperatively, from septicemia. There was a severe inflammation around the site of the implant with necrosis of the mucosa and general sepsis. I found out at this time that although tracheotomized humans present a problem in care, they are nothing compared to a tracheotomized dog with its larynx blocked.

Experiment No. 2: In the subcutaneous tissue of a dog was implanted a piece of airfoam rubber uncovered, airfoam rubber covered with a thin finger cot, airfoam rubber covered with goldbeater skin, and a piece of lucite. On the fourteenth day postoperatively, all of these implants, except the lucite, were extruding themselves through the incision. The lucite healed with only a small stitch abscess. Some of the foam rubber molds were sterilized by boiling; others by submerging in 70% alcohol for ten minutes and irrigated with distilled water. The white foam rubber seemed to give the same reaction as the black. It is evident that a special type of airfoam rubber must be used.

Experiment No. 3: We implanted lucite in three dogs—one without skin covering and two with skin covering, and sectioned the larynges. In two dogs we used penicillin daily, and omitted it in the third dog. Unfortunately, I cannot give good evidence of regrowth of squamous epithelium in the larynx, although I believe this can be done satisfactorily. The dog is an ideal animal for the experiment since it has so much squamous epithelium already within the cavity of the larynx. The following is the report of Dr. Plinn F. Morse of Harper Hospital on the experiments of lucite in the dogs' larynges:

"The sections from the larynges of the dogs present several interesting features:

"1. Differing from the human, squamous epithelium covers the entire area from the tip of the anterior surface of the epiglottis over the false cords and the ventricle and beyond the true cord. Also the section shows beautifully, in a dog, the myxomatous tissue lying beneath the true vocal cord which permits the movement necessary for the vibration of the vocal cords.

"2. The ulcerations of the larynx which have been produced artificially immediately present the picture of acute inflammation with a purulent membrane covering the ulcerated surface.

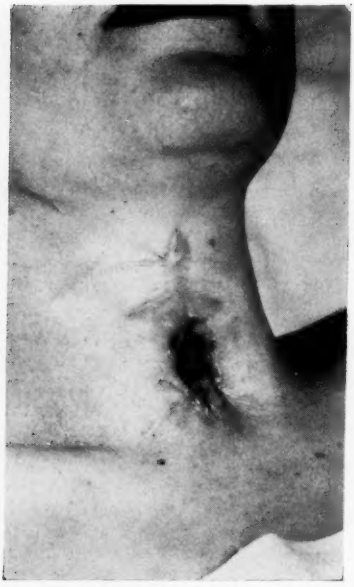

Fig. 4.—Keloid development of skin.

"The dogs that were given penicillin, while they have the ulcerating surface, do not show the polymorphonuclear infiltration of the purulent infection of the original experiments.

"3. There is no evidence that any epithelial graft has taken on the ulcerated surface. There are fragments of squamous and stratified epithelial covering here and there, which are evidently remains of the original surfaces.

"4. In the dogs in which the duration of the experiment was long enough, there is definite evidence of metaplasia of epithelium, the columnar epithelium changing to the squamous type.

"5. In many places the cricoid cartilage has been exposed and in these areas the cartilage is covered by a thin purulent membrane without any attempt at fibroblastic proliferation on the surface. It is evident that the area over the cricoid cartilage is an especially dangerous area and that granulations in this region will not take place

Fig. 5.—X-ray film showing acrylic mold in place.

unless some special technique can be devised to encourage the formation of granulation tissues.

"6. In one of the young dogs, there is quite active fibroblast formation arising on the cartilage surface from the cartilage itself and it would appear that the capacity of the young animal to heal the lesion was greater than that of the older dogs."

As previously stated in this paper, "Most of the mild forms of laryngeal stenosis can be relieved by dilatation with varying forms of bouginage. But the severe types seen as a sequel of automobile and airplane accidents with destruction of the entire laryngeal box may bring the most difficult problems in all surgery."

Under my care at the present time is a patient who had a crushing injury of her larynx in an automobile accident on November 23, 1947. She has run the complete gamut of tracheotomy, repeated bouginage, rubber mold, orally inserted acrylic mold, thyrotomy with

implantation of acrylic mold covered with skin, and still has to wear the mold to prevent contraction even though the skin implant could be clearly seen at both ends of the larynx. At present, I intend to leave in place this lucite mold for at least a year and, if possible, at the end of that time remove it to do the plastic operation suggested by New and Erich.

Figure 4 shows the keloid development in her skin indicative of her scar-forming tendency. An acrylic mold infiltrated with barium sulfate (made by Kenneth Corrigan, Ph. D.) is shown by x-ray in this patient's throat (Fig. 5).

SUMMARY

1. With the dwindling supply of expert intubationists, tracheotomy is the choice for treatment of laryngeal diphtheria with obstruction.

2. With the advent of streptomycin, laryngeal tuberculosis with stenosis will be a rare condition.

3. Severely crushed larynges, I believe, will remain always a serious condition for the laryngologist.

4. With the increasing number of patients using both indwelling endotracheal tubes and also indwelling esophageal tubes, a knowledge of their possible damage is imperative. My conclusions as to the size, the length of time these tubes should remain indwelling, and the material of which they should be made have been given. Some agreement among us on these three points would be helpful as a guide to the profession.

I wish to acknowledge the helpful suggestions of Plinn F. Morse, M.D., and Kenneth Corrigan, Ph. D., of the Research Laboratories of Harper Hospital.

641 David Whitney Bldg.

LVII

PLASTIC REPAIR OF SADDLE-NOSE

EDWARD D. KING, M.D.

R. C. BOYDEN, CAPTAIN, M.C.

AND

F. L. ASHLEY, LIEUT. COMMANDER, M.C.

LOS ANGELES, CALIF.

The history of the plastic repair of saddle-nose reveals that implants have waves of popularity and decline.

Paraffin, which was employed for the first time in 1901 by Eckstein, has been used extensively. Every now and then we see patients who have tolerated it for years with good cosmetic results. Vaselin was recommended by Gersuny[1] as early as 1887. Celluloid, ivory, gold, platinum and aluminum as well as bone and cartilage from animals have been tried and discarded. Ticonium and tantalum have been developed and used recently along with acrylic implants.

These materials are really foreign bodies and they were used in order to obviate the need for another operation.

Cortical bone from the tibia or crest of the ilium was tried and discarded because it absorbed rapidly.

Koenig[2] introduced autogenous cartilage in 1920. It has many advantages but at times it will curl and fail to form a firm union.

Carter[3] thought that a combination of bone and cartilage was necessary in saddle-nose so he used rib implant of bone and cartilage.

Ever since Pierce and O'Connor[4] introduced it in 1938, cadaver cartilage has enjoyed great popularity because it is so readily avail-

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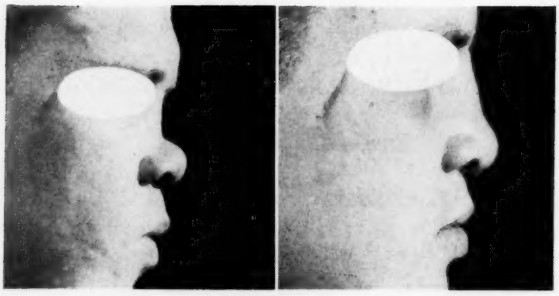
From the Otolaryngological Service of Navy Hospital, Long Beach, Calif.

Read before the meeting of the American Laryngological Association, New York City, May 16-17, 1949.



able. Recently there has been criticism of its use because it is said to absorb readily. Some surgeons have discarded it completely. We have seen it absorb rather promptly in a few cases and for that reason we decided to try cancellous bone grafts in a series of cases.

Cancellous bone has been advocated because it is highly resistant to infection and absorption and it forms a firm union with the surrounding area.

Recently, Abbott el al.[5] published the results of experiments with cancellous bone used in filling bony cavities. They found that it can be used safely and satisfactorily. They also proved that cancellous bone implants have the ability to regenerate bone. The bone marrow cells undergo rapid degeneration and provide wide channels for the invasion of new vessels and eventually for the accommodation of newly formed bone. It offers an opportunity for regeneration from all surfaces.

Mowlem[6] used cancellous bone from the ilium because of its porosity and high cellular content. He claims that the blood supply appears very early. Macomber[7] believes that all foreign substances should be abandoned. He is convinced that iliac cancellous bone is dependable, most useful and safest of all materials for correction of defects about the face. Gordon[8] employed bone chips in the presence of infection and found that they lived. He placed the chips in contact with bone denuded of its periosteum.

We wish to record our experience with a series of 20 cases of saddle-nose defects in which cancellous bone was used. The bone was obtained from the ilium in all cases. Casts of the face were made in some cases and photographs in all. The length of the defect was

measured with wood which was boiled with the instruments. Local anesthesia consisting of novocain and adrenalin was injected and an incision about three inches long was made under the edge of the iliac crest. The skin and subcutaneous tissues were divided and retracted. The periosteum over the external surface and near the edge of the bone was incised and a sharp chisel unroofed the cancellous bone by chiseling off the cortex and leaving it attached to the periosteum on the inner surface. The cortex was elevated and a gouge inserted to remove the cancellous bone graft which was grasped with a towel clip and stored in saline. The cavity was packed with Gelfoam and the wound closed with chromic catgut and skin clips.

Following the operation there were no infections and no hematomas. The disability following was not marked. The patients complained of slight discomfort. One patient complained of numbness in the right leg and lameness for about six weeks.

On three occasions we had two patients scheduled for implants; each time one donor was used for both implants thus correcting six defects with three donors. No difference in reaction nor in results was noted in these patients.

The bed for the implant was prepared after all necessary surgery on the nose was completed. In most cases it was necessary to fracture the lateral walls inward to narrow the nose and in about one-half of the cases the nasal tip was reconstructed. In most instances the implant was introduced through the vestibule; in a few it was introduced over the alar cartilages. A raw surface was obtained by rasping or elevating the periosteum. The implant was molded with the aid of an electric bur. While the operator held the bone with a towel

clip and a wet sponge the assistant operated the bur. The implant was held in place by adhesive straps and a tantalum splint. In a few cases a mattress suture of fine Dermalon was used to hold the splint in position.

CONCLUSIONS

Our experience shows that the bone implant "takes" readily and seems to form a firm union quickly. A few days following surgery the implant is firmly fixed with a very little reaction in the tissues. It appears to form an integral part of the nose within a week. No signs of absorption were noted in cases seen two years after the operation. The patients with bone implants from another donor had equally good results. We recommend the electric bur for modeling the implant.

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LVIII

HEMILARYNGECTOMY: METHOD OF MAINTAINING A SATISFACTORY AIRWAY AND VOICE

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Tumors of the larynx which are too extensive to be removed by cordectomy or laryngofissure but would be satisfactory for hemilaryngectomy, are not so treated since contraction of the glottis in healing is so great that the airway is useless; a permanent retention of the tracheotomy tube is necessary; thus, a total laryngectomy is the only practical procedure to follow, even though a part of the larynx might have been saved without any great danger of recurrence.

However, with the assurance of an open glottis, with ample breathing space and a useful voice minus an annoying tracheotomy opening, many patients can look with greater complacency upon an extensive operation of the larynx.

Even after total laryngectomy and healing, biopsy will reveal that the contracted scar tissue closing off the normal airway is only 1-2 cm. in length and is the chief obstacle to an airway between the trachea and the hypopharynx. I have been surprised at how near and yet how far this short barrier places the open trachea.

Some 16 years ago in an attempt to overcome this barrier following a total laryngectomy I sewed a large piece of rather heavy rubber tubing in this area as an obturator at the time of operation. The upper end of the tube was closed with sutures and the open end was in contact with the tracheotomy tube. This tube was removed six weeks after operation, and a urethral sound was used for some weeks later through the tracheal wound to maintain an open tract to the hypopharynx. This man, now aged 79, is still living and well (16 years after operation). By placing a finger over the tracheal

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Read before the meeting of the American Laryngological Association, New York City, May 16-17, 1949.

opening he is able to converse and on several occasions has talked to me over the telephone. The opening, however, is not of sufficient size for breathing.

After a number of years I was convinced that an ample airway could be obtained if a continuous tract of mucous membrane, even though narrow, could be maintained at operation between the trachea and the hypopharynx without undue risk of recurrence of the tumor.

I believe you will agree that given a carcinoma of one cord, with its removal by laryngofissure, recurrence does not occur in the opposite cord except by extension through the anterior commissure. Few surgeons have even seen a carcinoma in the interarytenoid space. There may be recurrence in the anterior pretracheal muscles as well as in the glands along the carotid sheath or the lateral pharynx or the mouth of the esophagus, but the opposite cord which was clean at the primary operation may still be smooth save for extension across the anterior commissure.

Where I have found carcinoma involving both cords I have also been able to find malignant tissue in the anterior commissure.

I shall cite the maximum of tumor extension in which I would attempt or advise a hemilaryngectomy.

If one-half of the larynx is free of any visible evidence of carcinoma even though the arytenoid on the opposite side is fixed, a hemilaryngectomy may be safely performed. A fixed cord may contra-indicate laryngofissure but not hemilaryngectomy.

Operation. Under local anesthesia or a cervical block the larynx is opened in the midline. Careful examination is made as to visible extension of the tumor. An incision is made in the midline in the interarytenoid area or slightly to the normal side. This incision is carried downward over the cricoid, or at least 1 cm. or more below the visible edge of the tumor.

Where the anterior commissure is involved it is my practice to remove normal cord tissue well beyond the lesion with cartilage, epiglottis, and all pretracheal muscle tissue in this area. I agree with Schall[1] that these muscles are rich lymphatic beds. This area is also rather severely cauterized which may produce some sloughing later. I have often felt this sloughing may be a blessing in disguise in further removal of questionable tissue.

Fig. 1.—Acrylium obturator.

The wing of the thyroid cartilage on the affected side is widely resected (not subperichondrially) including the arytenoid. Examination for lymph glands along the carotid is made at this time and a wide resection done if necessary.

After all bleeding points have been cauterized or ligated an attempt is made to line a part of the denuded area by drawing in and suturing mucous membrane from the region of the hypopharynx and the mouth of the esophagus. Similar use of mucous membrane to cover denuded areas in laryngofissures shortens convalescence.

A solid acrylium tube (Fig. 1) 9 cm. (3½ in.) long and 13 mm. in diameter (the diameter of a No. 8 tracheotomy tube), with one end perforated to fit over the convex curve of the tracheotomy tube, is placed in the larynx. The tube must rest firmly against the tracheotomy tube to prevent a fibrous membrane intervening, as may occur where wire or a metal stirrup is used.

The mucous membrane is now sutured about the upper portion of the tube, but not over the end of the tube which extends

freely upward into the pharynx and can later be readily seen with a pharyngeal mirror standing like a post at the base of the tongue, yet there is no complaint of irritation or coughing, or dysphagia, even though it may be worn for months.

The deep tissues and skin are closed without drainage.

A feeding tube is passed through the nose prior to the placing of the acrylic tube.

The acrylic tube must be worn for a sufficient length of time to permit the glottis to become lined with mucous membrane and to permit the surrounding tissues to heal and contract against the tube and form a dense hard wall of scar tissue. During the healing process the patient will speak by air escaping around the obturator when a finger is placed over the tracheotomy opening.

In the light of recent investigation carried on by Brown and McDowell[2] concerning the growth of mucous membrane in the trachea, I am led to believe that the good results previously obtained in operations for laryngeal stenosis were due to leaving the obturator for a sufficiently long time to permit the skin grafts to be replaced by mucous membrane.

The skin grafts as shown by Brown and McDowell do not undergo metaplasia, that is, transformation into mucous membrane. The skin is eventually replaced by ingrowing mucous membrane.

After hemilaryngectomy I have seen an excellent glottis when the obturator was worn but two weeks, but prefer to wait ten to twelve weeks before removing the tracheotomy tube and the acrylium obturator which is removed through the tracheotomy wound.

Selection of Obturator. Inert, nonirritating material plus the proper length and diameter constituted the chief problems in obturators. First, rubber tubing, then vulcanized rubber material were tried. Acrylium seems to be very satisfactory but it will not withstand boiling and alcohol also affects it.

At first, silver wire was used and sutures were passed through perforations in the tube and carried through the soft tissues of the neck in order to hold the obturator in place. This procedure proved

unsatisfactory. The tube was then fastened to the tracheotomy tube by means of silver wire. This method was also unsatisfactory. A small metal stirrup will suffice but an acrylium obturator, with a perforation for the tracheotomy tube in the slightly curved end reduces granulations in this area, which is important.

Should a separation of skin over the tube occur during healing it must be reclosed by sutures.

The establishment of a successful airway to the hypopharynx following total laryngectomy has not yet been accomplished, but it can now be done where more than one-half of the larynx has been removed.

Even in laryngofissures where the arytenoid has been widely removed, an obturator worn for two to six weeks will insure a much freer breathing space and fewer granulations.

The recent work of Daniel[3] has been most interesting and instructive on the regeneration of the trachea and bronchi in dogs. Metal or glass tubes were used to bridge the defect and a new tracheal or bronchial wall developed, lined with epithelium; even well-developed cartilaginous rings were formed, not from pre-existing cartilage, in a certain number of animals.

SUMMARY

I have shown that it is possible to establish an open tract between the trachea and hypopharynx after total laryngectomy, permitting the patient to speak.

I have presented an obturator which, when used at hemilaryngectomy, will assure an ample airway for breathing and for speaking after complete healing.

556 Doctors' Building.

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Society Proceedings

CHICAGO LARYNGOLOGICAL AND OTOLOGICAL SOCIETY

Meeting of Monday, December 6, 1948

THE PRESIDENT, DR. WILLIAM A. SMILEY, IN THE CHAIR

Headache and Neuralgia of Nasal Origin

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(Abstract)

The nasal space and, in particular, the accessory sinuses are often blamed for chronic head pain when the etiology cannot otherwise be easily explained. This fact apparently accounts for the frequency with which various surgical procedures have been performed within the nose and sinuses to relieve victims of chronic head pain. It is important, therefore, for any physician to know something about the mechanism giving rise to this disorder, and its many causes.

Headache associated with either decreased or increased intracranial pressure results from traction upon or displacement of pain-sensitive intracranial structures and is independent of generalized intracranial pressure changes per se. Brain tumor produces traction chiefly upon the large arteries, veins and venous sinuses, and certain cranial nerves. The headache of migraine seems to be due to dilation and distension of the extracranial and, possibly, the dural branches of the external carotid artery. The same is true of headache associated with hypertension; there is no direct relationship to the level of blood or pulse pressure.

The classification of headache herein given lists three main groups:

Headache from Systemic Disorders or General Disease.

1. Infectious diseases.

2. Circulatory disturbances: hypertension, hypotension.

3. Abnormal blood states: anemia, alkalosis, uremia, hypoglycemia, polycythemia, etc.

4. Gastro-intestinal disorders.

5. Miscellaneous: relaxation states, caffeine withdrawal, cerebrovascular syphilis, etc.

Independent Forms of Headache.

1. Migraine.

2. Histamine headache.

3. Headache of emotional origin.

4. Headache from disorders in the neck.

Headache from Disorder Localized within the Head.

1. Intracranial disease.

2. Ocular disorders.

3. Nasal space disease.

The "independent" forms of headache are often encountered in clinical practice. Some of the numerous reports on the use of histamine in treatment of headache lack convincing proof that the diagnosis of the etiology is correct, or that the therapy could be unquestioned as the source of relief. Williams' observations on physical allergy as a contributing factor are interesting. Consideration of the neuralgias must also be included; however, physicians should distinguish between headache and neuralgia. Many classifications of facial neuralgia, for instance, are complicated. It has been found useful to list the neuralgias in six groups:

The Facial Neuralgias.

1. Trigeminal neuralgia, primary and secondary.

2. Glossopharyngeal neuralgia, primary and secondary.

3. Vidian and sphenopalatine neuralgia.

4. Neuralgia from disturbances of the temporomandibular joint.

5. Atypical facial neuralgias.

6. Some rare affections such as:

(a) Geniculate ganglion neuralgia.
(b) Tympanic plexus neuralgia.
(c) Great superficial petrosal neuralgia.

The pain of vidian and sphenopalatine ganglion neuralgia may have a sudden onset, is severe, localized around or back of the eyeball, radiates to the temple, back of the ear to the occiput and into the neck or shoulder. Vail believed it represented an irritation of the vidian nerve in its course below the floor of the sphenoid sinus. Sluder described two syndromes from involvement of the sphenopalatine ganglion, one neuralgic and one "sympathetic," in which there are also vasomotor and secretory phenomena. Many neurologists seem unwilling to accept Sluder's explanation, but with newer knowledge regarding vasomotor disturbances it seems likely that this, rather than sinus inflammatory change, may account for some of the painful and probably all the vasomotor phenomena. Williams explains sphenopalatine neuralgia, particularly the sympathetic syndrome, on the basis of physical allergy. It seems probable that vidian or sphenopalatine neuralgia can be produced from inflammatory changes within a sinus, but that much of the picture would fit into Williams' theory of physical allergy.

In the atypical facial neuralgias the distribution of pain is within a circular area within the vascular supply of the head. Sympathetic phenomena such as lacrimation, edema, corneal injection, unequal pupils, blurred vision, and photophobia are present in about half the cases. The diagnosis is apparently made when the disorder does not fit into one of the well defined neuralgias. Many cases could be vasomotor disturbances on the basis of physical allergy.

Laymen, and many physicians, are prone to attribute symptoms of headache or neuralgia to the sinuses. It is probable, however, that mistakes in evaluating the role of the nasal space in the symptom of head pain, particularly a chronic pain, are due to an inadequate history and to lack of information on the problem of headache and neuralgia in general. Every clinician sees frequent cases of marked irregularity of the nasal septum, hypertrophied turbinates, and x-ray shadows indicating extensive changes within the sinus linings, where the patient's complaints do not include headache as a symptom. In contrast, instances of contact or congestive headache are frequently encountered in which the nasal interior shows only a moderate abnormality but in which prompt relief is obtained by simple shrinkage with ephedrine or by cocainization of the contact.

Therapeutic tests upon which otolaryngologists can rely in cases of acute rhinitis and sinusitis with suppuration are (1) simple shrinkage or cocainization in cases of congestive or contact headaches and (2) the effect of drainage and ventilation in cases of suppuration within any of the several sinuses. In cases of suspected vidian neuralgia, instillation of 4% cocaine into the sphenoid sinus will relieve pain; cocainization of the area over the sphenopalatine ganglion will relieve neuralgia of that nerve structure. It has been the writer's experience that when these tests are applied in cases of headache or neuralgia of chronic type, the tests are reliable in establishing whether or not the nasal space is an etiologic factor in the pain.

DISCUSSION

DR. JOHN R. LINDSAY: I have enjoyed very much listening to Dr. Boies' presentation of this problem. In his usual logical and clearcut way he has given us a very good résumé of the whole situation. I have only one or two additional comments to make.

We know that, because of the fact that the nasal sinuses sometimes are the origin of severe headaches, most patients with headaches of obscure origin eventually are sent to an otolaryngologist. The state of affairs now differs from that of ten or fifteen years ago, when the cause for these severe headaches was usually considered to lie in the nose. One of the faults in former days was in not taking an adequate history. The more recent recognition of the part played by emotional states and vasomotor disturbances has done much to change the tendency toward doing unnecessary surgery in the nose. We are all familiar with patients who have pain in the head or face, who have had an ethmoidectomy, an antrum window, removal of the turbinates and the teeth, and still have pain. A careful history and evaluation should avoid such unnecessary surgery.

In many cases the response to intranasal treatment is not reliable. In some cases almost any intranasal treatment seems to afford temporary relief of headache. Sometimes it appears that one is dealing with a reflex action in response to pain, irritation or vasoconstriction in the nose.

I was interested to note that Dr. Boies finds the classical histamine headache very rarely; sphenopalatine neuralgia is also a rare occurrence. We still inject some cases with alcohol, usually because the neurosurgeon wishes us to do so, but they are rare cases.

I think that treatment and diagnosis of headaches in general have improved in recent years so far as the rhinologist is concerned,

but we must admit that there is still a great deal to be done. While we recognize that some cases are vascular in type, we do not always have an effective treatment to offer.

DR. ROBERT LEWY: About three years ago the Academy had a panel discussion on headache. One cause discussed at that time was light sensitivity, associated with vitamin A deficiency. I have had occasion to make that diagnosis in several cases, in each of which the patient's headaches ceased when given large doses of vitamin A daily. I would like to have Dr. Boies' opinion on the role played by vitamin A deficiency.

DR. WILLIAM A. SMILEY: I should like to ask about vasomotor disturbance in migraine. Is it vasoconstriction or vasodilation? The ophthalmologists have told us that when migraine is present the arteries of the eye are like a cord. If it is vasoconstriction how can we reconcile our use of ergotamine tartrate?

DR. LAWRENCE BOIES (closing): In answer to Dr. Lewy, I know nothing about light sensitivity as a cause of headache. I have heard ophthalmologists mention light sensitivity associated with vitamin A deficiency, and can believe that this sensitivity could well be a cause of a certain amount of headache.

Dr. Smiley asked about vasomotor disturbance in migraine. I mentioned the work of Wolff and his co-workers, who have contributed experimental evidence to show that the headache of migraine arises chiefly from dilation and distension of certain branches of the external carotid artery. It is increased amplitude of pulsation in a terminal branch, such as the temporal artery, which causes the pain. The effectiveness of such preparations as ergotamine in relieving the headache is the action in reducing the amplitude of the pulsations of the cranial vessels which are abnormally active. I do not believe constriction of retinal vessels is an important diagnostic sign in migraine, but I know it has been observed in some cases. The retinal arteries are branches of the internal carotid artery, and I presume vasoconstriction could occur in these vessels along with vasodilation in certain terminal branches of the external carotid.

Dr. Shapiro asked a question about the significance of vasomotor changes in the nose. In my experience, many factors may play a role in vasomotor changes associated with nasal congestion. Nasal congestion is, of course, extremely common and, in occasional cases, might be associated with cerebral congestion; it might be under certain circumstances such as histaminic cephalgia, but more often it

is a more localized phenomenon in the nose. Headaches resulting from congestion localized in the nose are relatively mild. The therapeutic tests of simple shrinkage or cocainization as a means of relieving the headache are in my experience quite reliable in determining whether or not the source of the headache actually originates in this congestive change. I am not averse to prescribing vasoconstrictors on a temporary basis for relief.

Congestive changes in the nose are common in systemic aspects of endocrine activity although there is nothing about these congestive changes which are characteristic. The more common occurrences are seen both in hyper- and hypothyroidism, at the menses in some women, and in adolescence.

The Function of the Ear in Health and Disease: Sound Motion Picture

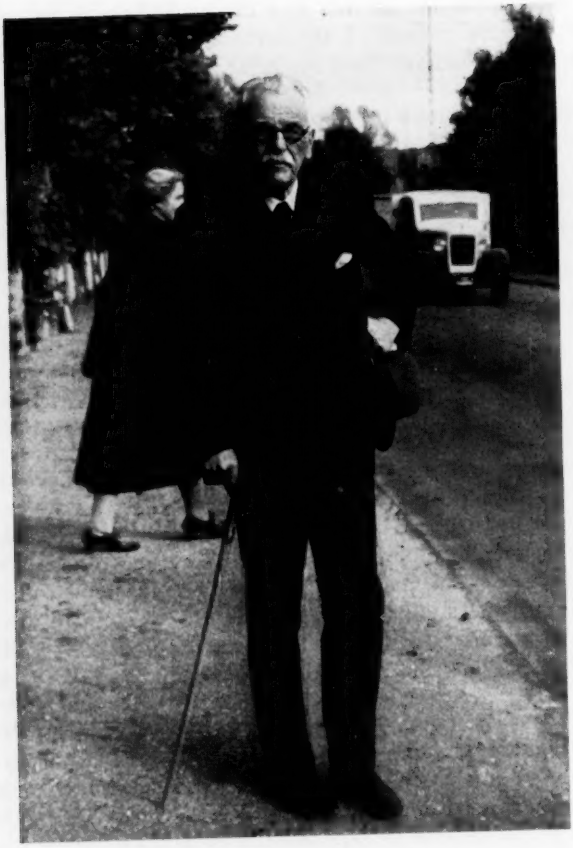
HEINRICH G. KOBRAK, M.D.

CHICAGO, ILL.

Otologists celebrate this year the one hundredth anniversary of Helmholtz' work. Since that time all work on the function of the ear has been based upon, or at least influenced by, the fundamental work of Helmholtz. Notwithstanding many contributions and in spite of numerous unexplainable findings, the Helmholtz theory of hearing is still the leading theory on the function of the ear. Our teaching of the hearing mechanism is based not on direct observation but on the interpretation of anatomic studies and psychologic findings.

Discussion of the merits or faults of the Helmholtz theory is not the purpose of this presentation. The history of physiologic research has shown again and again that theories become unnecessary if and when an ample amount of experimental evidence becomes available. One hundred years after Helmholtz it appears apropos to review the available experimental methods.

Based on these conceptions the motion picture camera was chosen for the recording of acoustical vibrations within the ear. The film records with a minimum of interference of the delicate tissues; no direct contact is made with the structures. Once the phenomena are recorded they can be projected on the screen, and thus new details which may have been overlooked in the initial observation may be discovered.



E. C. Amizelow

ERNST SCHMIEGELOW, M.D.

1856-1949

Ernst Schmiegelow, dean of Danish otolaryngologists, died in Copenhagen on February 28, 1949, at the age of 92.

Although known in this country chiefly for his work on the surgery of the larynx, he was a constant contributor to the literature of otolaryngology and, in the course of a long life, published something over 200 papers and essays dealing with all branches of the specialty. He enjoyed the esteem and friendship of otolaryngologists all over the world, many of whom were at some time his guests in Copenhagen. During his active years he was a frequent participant in the international congresses of otolaryngologists and a dominating figure in Scandinavian medicine.

After a preliminary training in Leipzig, Schmiegelow made the grand tour of famous laryngologists including Morell Mackenzie, Felix Semon, Politzer, Urbantschitsch and Schwartze.

On his return to Denmark he began practice there as the first otolaryngologist in that country. He was instrumental in establishing the first otolaryngological clinic there and played a leading role in the subsequent development of the specialty in Denmark, where it has since attained distinguished proportions. He served as an associate editor of the *Acta Oto-laryngologica* from its beginning.

For several years before his death he was the oldest member of the American Laryngological Association, of which he had become a Corresponding Fellow in 1896.

Those who knew him well remember him to the last as a rugged, active old man, fond of outdoor sports, music and the company of his friends. The accompanying photograph shows him in 1938, at the age of 81, setting out with a group of colleagues for a dinner in the country.

He was buried with high honors in Copenhagen Cathedral.

Abstracts of Current Articles

EAR

The Incidence and Treatment of Infective Ear Disease in Factory Employees.

Johnston, Colin M.: Brit. J., Dec. 18, 1948, pp. 1049-1059.

The high incidence of chronic suppurative otitis media is due to neglect. To support this statement Johnston calls attention to the report of Banham who was able to obtain a dry ear in 82.5% of 200 cases of chronic suppurative otitis media in the R. A. F. personnel.

In school children and in the armed services conditions are usually favorable for regular daily treatment even if extended over a long period of time. In these clinics otological supervision is necessary although a weekly or biweekly visit by the otologist may suffice. The actual daily treatment of the ear is carried out by trained nurses and orderlies.

Factory workers will not or cannot take the time from their work to make daily visits to an otologist or otological clinic over an extended period of time. They, therefore, neglect the care of a condition which is annoying but not incapacitating. Johnston was appointed by the National Research Council to investigate the possibility of treating these individuals at the place of their employment. Upon the examination of some 1,900 workmen in a group of factories at Birmingham, he found an incidence of 5.9% of active ear suppuration and evidence of former disease in 14.6%. He set up otological clinics in the factories themselves and showed that given a certain minimum of skilled otological supervision, he was able to cure over 80% of the cases at least temporarily. The very nature of the disease makes relapse inevitable in some cases and this is an added reason for regular treatment being readily available. Furthermore, these results which compare favorably with those already mentioned were obtained without any expansion of the regular medical and nursing service of the factories apart from a weekly visit from an otologist. The most important finding of all is that daily treatment can be continued over many weeks without time off from work. It has been demonstrated that the management of infective ear disease

can be extended in hospitals, school clinics and factory medical departments without adding unduly to the burden of work and without taking children from their schools and workers from their jobs.

GROVE.

NOSE

An Unusual Case of Frontal Sinusitis.

Webb-Jones, Arthur: Brit. Med. J., Feb. 26, 1949, p. 351.

This case, which Webb-Jones considers unusual, concerns a male, 23 years of age, who had had a moderately severe headache for three weeks after an ordinary head cold. There was swelling and edema over the left frontal sinus with slight downward displacement of the left eye. An external frontal sinus operation revealed a sinus full of creamy pus, with pus also exuding through the posterior bony wall which was removed. The dura was covered with granulations. Intensive penicillin and sulfamezathine therapy was used and the patient made an uneventful recovery.

GROVE.

Intranasal Application of Buffered Tripelennamine (Pyribenzamine) Solution in Allergic Rhinitis. A Preliminary Report.

Brem, Jacob, and Zonis, Jonathan: J. Allergy 20:70 (Jan.) 1949.

The authors employed a 0.5% buffered solution of Pyribenzamine, applying it locally to the nasal mucosa. Dosage was two or three drops every three or four hours. This was given to patients with perennial allergic rhinitis who had responded poorly to other types of therapy; to patients with ragweed pollinosis who had responded unsatisfactorily to preseasonal desensitization; and to new, untreated cases of ragweed pollinosis. Unfortunately the number of patients in each group was small, and the groups were of unequal size; these factors cast doubt on the validity of conclusions based on percentages. However, in the authors' opinion, there was a difference in response. They felt that best results were obtained with the previously desensitized ragweed pollinosis cases, and poorest results in the cases of perennial allergic rhinitis. The over-all response, without regard to grouping, was very satisfactory, and they highly recommend this method of therapy. No untoward effects were noticed; very often local application was effective when oral administration of Pyribenzamine was not.

SULLIVAN.

Anthisan in Perennial Vasomotor Rhinorrhoea.

Reid, J. T., and Hunter, R. B.: *Lancet* 2 (Nov. 20) 1948.

The authors used anthisan on 37 patients, all of whom had had the typical symptoms of rhinorrhea, sneezing and nasal blockage for at least six months and on nasal biopsy showed a characteristic allergic histology. Cases with sepsis and large polyps were excluded. Before the anthisan therapy, all the patients were given dummy tablets of a similar appearance for two weeks. This was done to exclude the emotional factor and to train the patients to take the tablets regularly. The results were as follows:

	Inactive Tablets	Anthisan
Complete relief with return of nasal mucosa to normal	2 cases - 5%	19 cases - 54%
Some relief	13 cases - 35%	12 cases - 34%
No relief	22 cases - 60%	4 cases - 12%

In the 13 cases, or 35%, which experienced some relief from the inactive tablets the appearance of the nasal mucosa was unaltered. None of the patients who obtained complete symptomatic relief and a reversion of the nasal mucosa to normal reported for further treatment in six months, although they were instructed to do so if their symptoms recurred.

The authors conclude that over half of the cases with perennial vasomotor rhinitis can be cured, at least temporarily, by anthisan, and that 35% more obtain some symptomatic relief, although the appearance of the nasal mucosa and the result of the nasal mucosa biopsy suggest that this effect may be psychological.

GROVE.

LARYNX

Cancer of the Larynx.

Jackson, C. L., Blady, J.V., Norris, M., and Maloney, W. H.: *J. A. M. A.* 138: 1080 (Dec. 11) 1948.

This is a statistical study on five-year end results in a series of 612 patients treated between 1930 and 1942. The treatment consisted of: laryngofissure or thyrotomy, total laryngectomies, and ir-

radiation alone. Continued post-treatment, observation for these five years and preferably for life is advised for all cases, and the prompt institution of intensive treatment, surgical or irradiative, or a combination of the two, is necessary in the case of recurrence or metastasis if salvage of failures of initial treatment is to be secured. Criteria for the selection of treatment should be constantly studied and re-evaluated in the light of end result analyses, and technique of treatment should likewise be re-evaluated and modified according to experience. Cancer of the larynx has a hopeful prognosis, if recognized early and experienced treatment is instituted.

Additional statistics on large series of cases are supplied by the discussors.

BOIES.

Paralysis of Left Vocal Cord Following Streptomycin Therapy.

Gundrum, L. K.: *J. A. M. A.* 138:22 (Sept. 4) 1948.

A case is reported of laryngeal paralysis occurring during the administration of streptomycin to a 33-year-old woman who had undergone an operation for ptosis of the kidney. It is not stated just why streptomycin was administered. It was given about two weeks postoperatively and in a period of eight days 11 gm. of streptomycin and 2,000,000 units of penicillin were given intramuscularly. Twelve days following the final dose of streptomycin the patient complained of some difficulty in swallowing liquids and the sensation of a lump in her throat. Ten days later hoarseness was noted. An examination of her throat two weeks later showed complete paralysis of her left vocal cord. The reaction to an intradermal test of sensitivity to streptomycin was negative. There was no evidence in a general examination of the patient that there was any disease in the chest or neck which could account for the paralysis. The patient was treated with large doses of vitamin B complex. One month after the paralysis had first been diagnosed the patient had not improved.

There is not conclusive proof that this paralysis was a result of an involvement of a recurrent nerve due to streptomycin sensitivity. However, the circumstantial evidence supports this possibility.

BOIES.

BRONCHI

Bronchogenic Carcinoma.

Graham, Evarts A.: Wis. Med. J. 48:232-234 (Mar.) 1949.

In 1912, Alder, in an exhaustive survey of the world's literature, could find only 374 cases of lung cancer. Today the lung is known to be one of the most common sites of cancer. Unfortunately, most of the patients referred for surgical treatment have cancers far too advanced to be removed. Between January 1, 1945, and September 20, 1948, Graham reports 434 proved cases but only in 101 or 23.3% was it possible to carry out a pneumonectomy. In 49 more cases an exploratory operation revealed the cancer too advanced for resection and in the remaining 42% the disease was obviously too advanced for surgery.

Bronchogenic carcinoma is about six times as frequent in males as in females. The first symptom is usually cough with sputum which sooner or later becomes blood streaked. Later symptoms include pain, loss of weight, weakness, pleural effusion, paralysis of the phrenic or recurrent laryngeal nerves, etc.

The examination includes x-ray studies, both with and without the use of lipiodol; examination of sputum, bronchial secretions and pleural fluid for cancer cells; and exploratory operation if necessary. If the growth is accessible to the bronchoscope the most successful method of examination is to obtain a piece of tissue for biopsy. Unfortunately, a diagnosis can be made in this way in only about 65% of the cases. Even by combining a bronchoscopic examination with an examination of secretions for cancer cells a positive diagnosis can only be made in 85% of the cases. In the remaining 15% an exploratory operation is necessary.

Up to 1933 there was no successful treatment for the condition. Lobectomy had been performed in a few cases but this operation did not permit the removal of a sufficient number of lymph glands. In April, 1933, Graham performed the first one-stage removal of an entire lung. Since then 311 such operations have been performed at Barnes Hospital in St. Louis. In the early years the mortality was 50%. From January 1, 1945, to September 20, 1948, 101 such operations have been performed with only seven deaths. Graham reports a 28% five-year survival rate.

The most important immediate aspect of the problem of bronchogenic cancer seems to be the education of the profession in the recognition of the early signs.

GROVE.

MISCELLANEOUS

Therapy of Migraine.

Marcussen, R. M., and Wolff, H. G.: J. A. M. A. 139:198 (Jan. 22) 1949.

The therapy of migraine falls into two categories: treatment of the attack and prevention of recurrences.

Many of the preheadache phenomena are associated with intracranial vasoconstriction. Intracranial vasodilators abolish the initial symptoms which may sometimes but unpredictably abort the headache. Headache is associated with painful vasodilatation of cranial arteries. Ergotamine tartrate parenterally is the drug of choice for the management of this stage and is most successful when administered at the onset of the headache. Emotional reactions and attitudes that result from accumulated tension and fatigue set off a series of bodily changes which result in the migraine attack. Reduction in frequency and severity of attacks depends on identification and modification of stressful factors in the relationship of the patient to his environment. About two persons out of three can be helped, in terms of reduction of frequency and severity of headache by re-orientation of the patient relative to the useful factors and attitudes.

BOIES.

Aureomycin, a New Antibiotic.

Finland, M., Collins, H. S., and Paine, T. F., Jr.: J. A. M. A. 138:946 (Nov. 27) 1948.

To date, available information on aureomycin indicates that this new antibiotic is of low toxicity, is effective in vitro against a large variety of gram-positive and gram-negative bacteria, and particularly effective in experimental infections with rickettsias and with viruses of the psittacosis-lymphogranuloma of the venereum group. This report is based on 100 cases studied, consisting of a variety of bacterial infections.

Toxic effects were minimal and infrequent. The commonest complaints during large oral doses of aureomycin was looseness of the bowels with frequent stools but true diarrhea was uncommon. Nausea and occasionally vomiting occurred after one or more doses in a few patients, but could not always be related to the treatment. Anemia attributable to the drug did not occur and no depression of

the cells of the granulocytic series was observed. There were no instances of jaundice or any other evidence of liver impairment developing after treatments started. No fever nor rashes definitely ascribable to the drug were observed.

The observations made suggest that aureomycin has definite antibacterial activity against many micro-organisms including cocci and bacillary forms, and it may prove useful in the treatment of infections with the organisms that are resistant to penicillin or to streptomycin. Results in these 100 cases indicate that aureomycin may be useful in a large variety of bacterial infections in addition to the treatment of infections with rickettsias or with certain viruses.

BOIES.

Stomatitis Due to Streptomycin.

Beham, H., and Perr, H.: *J. A. M. A.* 138:495 (Oct. 16) 1948.

This report deals with three cases of painful stomatitis, at first resembling the aphthous variety, which developed during the treatment of pulmonary and extrapulmonary tuberculosis with streptomycin. Many reports of toxic reactions following the use of streptomycin appear in the literature. One of the most constant of these reactions is temporary or permanent impairment of the eighth nerve. No other neurologic involvement following streptomycin therapy has been reported. Local irritations at the site of injection, fever, dermatitis, pruritis, rhinitis, conjunctivitis, swelling of the buccal mucous membranes, flushes and eosinophilia have all been noted, either singly or in combination, and are considered manifestations of hypersensitivity to the drug. These cases consisted of severe erosive and membranous stomatitis which occurred during the administration of streptomycin for the treatment of pulmonary and extrapulmonary tuberculosis. Lesions healed rapidly after treatment with the drug was discontinued. The fact that the lesions re-appeared on resumption of treatment with streptomycin indicated that the stomatitis was caused by the antibiotic.

BOIES.

Inhalation of Penicillin Dust.

Krasno, L., Karp, M., and Rhoads, P. S.: *J. A. M. A.* 138:344 (Oct. 2) 1948.

Preliminary results have indicated that the inhalation of penicillin dust is an effective and practical method of treatment of many types of infections of the respiratory tract. The present report

consists of extensive studies of this procedure carried out on 357 patients since October, 1946.

A simple apparatus was developed for the inhalation of the dust, making penicillin inhalation easily available for home and office use.

The 357 patients were administered 100,000 units of penicillin dust by inhalation one to three times daily. Inhalation therapy was continued at home for varying periods of time in all cases of bronchiectasis.

The throat, nose and sputum cultures showed decidedly decreased gram-positive bacteria. In these cases the gram-positive bacteria decreased also.

The penicillin blood level curves indicated absorption from the respiratory tract. Maximum levels of penicillin in the blood are obtained one hour after inhalation. Therapeutic levels are maintained for a period of five hours following the inhalation.

The incidence of allergic reaction in the 357 patients treated by this method was 3-6%. The reactions were local in character, manifested as contact dermatitis, stomatitis and posterior pharyngeal irritation. It would seem that the gradual rate in the extent of absorption of penicillin dust accounts for the low incidence of systemic reaction.

Streptomycin dust is now being used. With the exception of one case of stomatitis, no untoward reactions have been noted.

While inhalation of penicillin dust almost invariably produced improvement in all types of bacterial infections of the upper part of the respiratory tract, it should again be emphasized that it cannot always be relied on as the total treatment of these infections, to the exclusion of intramuscular or intravenous administration of penicillin, attention to allergic sensitivity, local drainage of sinuses and bronchiectatic cavities, and the like.

BOIES.

Tumors of the Neck.

Labey, F. H.: J. A. M. A. 138:264 (Sept. 25) 1948.

This excellent article by a famous surgeon was presented before the General Practitioners' Session at the Cleveland interim meeting in

1948. It contains a complete classification of tumors of the neck. It is illustrated by photographs and drawings. From his wide experience the author concludes that tumors of the neck are not uncommon and because of the fact that malignancy is not rare in them, it is important to determine their character as early as possible. Exclusive of the lipomas which can occur anywhere in the neck, and can usually be diagnosed by their consistency and demonstrable lobulation, there are almost no tumors in the neck which should not either be promptly biopsied or removed after discovery. Diagnosis of tumors of the neck can be extremely simple, or only possible after exploration or biopsy, and since many of the malignant tumors of the neck will prove to be radiosensitive lymphomas, microscopic demonstration of this character should not be delayed.

BOIES.

The Occurrence of Superinfections During Antibiotic Therapy.

Appelbaum, E., and Leff, W. A.: J. A. M. A. 138:119 (Sept. 11) 1948.

It has been frequently observed that during the course of treatment with an antibiotic a complete change in the bacterial flora may occur. In these circumstances the pathogens sensitive to the antibiotic in use disappear or become less numerous, and insensitive organisms may appear in large numbers and cause a new infection. For example, when using penicillin for infection caused by a gram-positive organism one may encounter a secondary infection caused by a gram-negative bacillus. The reverse may be obtained when one uses streptomycin.

Two cases of pneumococcic pneumonia are reported in which during the course of penicillin new infections due to organisms not susceptible to that antibiotic occurred. In the first case a course of penicillin therapy resulted in clinical improvement with disappearance of the pneumococci from the blood and sputum. This was followed by the emergence of gram-negative bacilli, identified as E. coli and A. aerogenes, and a simultaneous aggravation of the clinical picture requiring the use of streptomycin. The first case of pneumonia was complicated by congested heart failure and empyema. After the administration of penicillin intramuscularly and intrapleurally the gram-positive organism disappeared from the sputum and pleural fluid. However, there occurred a new infection due to E. coli and A. aerogenes. The institution of streptomycin therapy led to clinical improvement in the disappearance of the gram-negative pathogens. In both cases during the administration of streptomycin the gram-positive cocci returned necessitating supplementation with penicillin.

The occurrence of superinfections in patients receiving penicillin or streptomycin serves to emphasize the importance of frequent and careful bacteriologic examinations before and during the course of treatment.

The authors do not believe that the combined use of penicillin and streptomycin to prevent the occurrence of superinfections is warranted, however, since the incidence of new infection does not appear to be high. Also one objection to a treatment with both drugs is the possibility that sensitization of these patients might occur. It therefore seems best to watch for new infections and use each antibiotic in a specific manner, depending on the precise bacteriologic observation at a given stage of the disease.

BOIES.

Oral Reactions to Penicillin.

Gross, W. G.: Brit. Med. J., Jan. 29, 1949, pp. 171-173.

Gross presents a survey of the literature in which oral reactions to penicillin such as black tongue, aphthous stomatitis, pharyngitis and glossitis occurred after the oral administration of penicillin. He presents in all a total of 59 cases of oral reactions to penicillin, 36 from the literature, 12 reported in personal communications and 11 which he himself had observed.

Discoloration of the tongue occurs in 30% of the patients taking penicillin continuously for oral conditions. It soon disappears after discontinuation of treatment. It is absent on the sides and tip of the tongue.

Stomatitis and glossitis when encountered usually made their appearance between the third and sixth day of treatment, caused marked soreness of the tongue, mouth and pharynx and remained for about a week. Gross believes that these reactions do not occur until there has been a complete change in the character of the oral flora.

GROVE.

Palliative Surgery in Facial Palsy.

McLaughlin, C. R.: Lancet 1:255-258 (Feb. 12) 1949.

McLaughlin deprecates the use of tantalum or stainless steel wire because of the electrolysis set up where there are teeth fillings

and the subsequent disintegration and fragmentation of the wire and the necessity for its subsequent removal.

He also deprecates the method of implanting fascia lata strips and incorporating them in the temporal and masseter muscles on the ground that the biological function of these muscles is sucking and chewing, and if they are employed or transplanted the patient cannot avoid "making faces while eating."

To prevent sagging of the corner of the mouth after injury to the facial nerve, he employs two strips of fascia lata, one of which is incorporated in a figure of eight pattern in the upper and lower lips. The other strip is sutured around the figure of eight, brought up subcutaneously through a hole in the malar bone from back to front and sutured to the periosteum of the bone. The introduction of these two fascia lata grafts is made possible by an incision over the malar bone, three small incisions about the mouth and the use of a Blair fascia needle.

The results of this operative procedure to produce a supporting sling for the corner of the mouth have been encouraging.

The article must be read for the exact operative technique.

GROVE.

Effects of Benadryl on Systemic Manifestations of Cold Hypersensitivity.

Rothschild, J. E.: J. Allergy 20:62 (Jan.) 1949.

This is a case report; the patient was studied by the author in an attempt to determine the importance of histamine in cold allergy. It has been the thought of some previous investigators that a vagus effect, with release of acetylchlorine, is the mechanism of production of physical allergy. Acetylcholine is not antagonized by the antihistaminics. In this patient it was found that reproduction of the cold response was associated with an abrupt increase in the total gastric acidity, suggesting histamine release. Pretreatment with Benadryl was followed by failure to reproduce local edema on immersion of the extremity in cold water, and an absence of change in the level of total gastric acidity. This case report does not disprove the theory of acetylcholine participation in physical allergy, but it does demonstrate that one of the so-called antihistaminic drugs is effective in the management of some of these patients.

SULLIVAN.

Books Received

Language and Language Disturbances: Aphasic Symptom Complexes and Their Significance for Medicine and Theory of Language.

By Kurt Goldstein, M.D. Pp. 374, New York, Grune and Stratton Publishing Co., 1948.

This important contribution to the understanding, diagnosis and retraining of the aphasic patient is, as the author points out in his preface, a "philosophic" study, in that it is not only medical or physiological in its approach but must of necessity incorporate problems of a psychological and linguistic nature. As a result the entire study should be of interest to physicians, surgeons, psychologists, and speech pathologists alike. The author has sought to share with them the results of over 40 years of study of the highly specialized and complex phenomena of aphasia.

The book is organized in two parts. Part One deals with "The Origin of Aphasic Symptoms." Chapter I presents a discussion of the origin of symptoms in brain damage. The author groups the symptoms according to their origin into four categories, i.e., symptoms of defects of performance, indirect symptoms due to separation of the damaged area from the undamaged area, depending on secondary symptoms due to the effect which the "pathologic process in the damaged area exerts in other parts of the nervous system," and symptoms of a protective nature which serve to "avoid catastrophic conditions."

Chapter III differentiates between the atomistic theory of brain physiology and the author's organismic concept underlying the aphasic phenomena. He interprets the purpose of language as being "a means of the individual to come to terms with the outer world and to realize himself."

"A Survey of the Various Forms of Disturbance of Language in Pathology" is presented in Chapter IV. The author gives us first a detailed analysis of the significant modifications of language and secondary performance which characterize aphasia in general, followed by a description and discussion of the various types of aphasia.

Part Two is entitled "Case Reports, Pathologic Anatomy, Treatment." In this section the author has reported in detail clin-

ical cases which characterize the various types of aphasia. The interpretation of the case findings justify the detailed theoretical and philosophic study of Part One, and present the reader with concrete illustration of the complexity of the problem.

Chapter X deals with the treatment of aphasia. The author points out that "retraining can be expected to be successful only if it is performed with great effort, skill and spending of much time." This chapter leaves much to be desired in view of the more modern educational methods and procedures.

Dr. Goldstein has written about a complex subject. He has expressed his ideas in highly scientific terminology, in complicated and involved sentence structure, and in "wordiness." The reader should be warned that he has "set a task" for himself when he sets out to digest the contents, but anyone sufficiently interested in the phenomena of aphasia will find his thinking challenged and his time spent fruitfully.

RUSH.

Geriatric Medicine. The Care of the Aging and the Aged.

By Edward J. Stieglitz, M.S., M.D., F.A.C.P., Attending Internist, Suburban Hospital, Bethesda, Maryland, (Chairman Staff, 1945-47); Doctor's Hospital, Washington, D. C.; Attending Internist (Geriatrics), Chestnut Lodge, Rockville, Maryland; Consulting Internist, Washington Home for Incurables; Associate, Washington School of Psychiatry; Special Lecturer, Institute of Industrial Medicine, New York University, Bellevue Postgraduate Medical School, New York City; Formerly Associate Clinical Professor of Medicine, Rush Medical College, the University of Chicago. Washington, D. C. Ed. 2, pp. xvii+773, with 180 illustrations. Philadelphia and London, W. B. Saunders Co., 1949. (Price $12.00)

This is the second edition of a work which rapidly claimed a place as the standard text on the subject in this country. It is the combined effort of almost 50 collaborators and is distinguished by a thorough and detailed presentation.

The format is pleasing and the illustrations are adequate. The publishers have taken a leaf from their own book and have rejuvenated the cover.

Notices

WASHINGTON UNIVERSITY

The Department of Otolaryngology, Washington University School of Medicine, Saint Louis, announces an eight months' course in otolaryngology beginning October 3rd, 1949.

Address communications to The Registrar, Washington University School of Medicine, Euclid Avenue and Kingshighway, Saint Louis 10, Missouri.

UNIVERSITY OF ILLINOIS
COLLEGE OF MEDICINE

POSTGRADUATE COURSES IN OTOLARYNGOLOGY

BRONCHO-ESOPHAGOLOGY

Doctors Paul H. Holinger and Albert H. Andrews will supervise courses of two weeks' duration given three to four times a year. The next course is planned for September 19th to October 1st, 1949.

OTOLARYNGOLOGY

A nine months' basic course beginning October 3rd, 1949, will be given under the direction of Doctor Francis L. Lederer. This course is prerequisite to the Residency Training Program.

For application forms and further information, communicate with the Postgraduate Division (Otolaryngology), University of Illinois, 1853 West Polk Street, Chicago 12, Illinois.

THE NATIONAL COMMITTEE FOR CHILE

The National Committee for Chile is now receiving gifts for the library of the medical school of the University of Chile at its new collection center in the Library of Congress, Washington. The newer materials in the library, including periodicals, books and reference materials, were totally destroyed in the recent fire. Medical periodicals of the last ten years and recent medical books are urgently needed. Your contribution will be appreciated.

National Committee for Chile, Room 318, Library of Congress, Washington, D. C.

HOME STUDY COURSE

Home Study Courses in the basic sciences related to ophthalmology and otolaryngology, offered as a part of the educational program of the American Academy of Ophthalmology and Otolaryngology, will begin on September 1st and continue for a period of ten months.

Registration must be completed before August 15th. Detailed information and application forms may be secured from Dr. William L. Benedict, the executive secretary of the Academy, 100 First Avenue Building, Rochester, Minnesota.

II PAN-AMERICAN CONGRESS OF OTORHINOLARYNGOLOGY AND BRONCHO-ESOPHAGOLOGY

The II Pan-American Congress will be held at Montevideo and Buenos Aires January 8-15, 1950.

The official themes will be as follows:

1. Frontal sinus.
2. Tumors of the pharynx.
3. Lesions of the mouth, pharynx and larynx caused by fungi or parasites.
4. Methods of treatment of laryngeal cancer to preserve function.
5. Bronchial obstruction in children.
6. Noncancerous lesions of the esophagus.
7. Speech perception.
8. Hearing aids.
9. Otosclerosis.

Presentations will be confined to these subjects and notice of the intention to participate, together with a summary, must be in the hands of the Secretary before November 15, 1949. The official languages will be Spanish, Portugese and English.

Secretary: Dr. Pedro Regules, Calle San José 1092, Montevideo, Uruguay.

AMERICAN BOARD OF OTOLARYNGOLOGY

The American Board of Otolaryngology will conduct the following examinations in 1950:

January 8-11 in New Orleans, Louisiana, at the Hotel St. Charles.

May 17-20 in San Francisco, California, at the Hotel Mark Hopkins.

October 3-6 in Chicago, Illinois, at the Palmer House.

HEARING AIDS ACCEPTED BY THE COUNCIL ON PHYSICAL MEDICINE AND REHABILITATION THE AMERICAN MEDICAL ASSOCIATION

(List Corrected to June 1, 1949)

Acousticon Model A-100
Aurex (Semi-Portable)
Aurex Model C-B and Model C-A
Aurex Model F
Aurex Model H

Beltone Mono-Pac
Beltone Harmony Mono-Pac

Dysonic Model No. 1

Electroear Model C

Gem Hearing Aid Model V-35

Maico Type K
Maico Atomeer
Mears Aurophone Model 200
1947-Mears Aurophone Model 98
Micronic Model 101 (Magnetic Receiver)
Microtone T-3 Audiomatic
Microtone T-4 Audiomatic
Microtone T-5 Audiomatic

National Cub Model
National Standard Model
National Star Model

Otarion, Model A-1
Otarion, Model A-3
Otarion, Models A-4 J & S
Otarion, Model E-1
Otarion, Model E-1S
Otarion, Model E-2
Otarion, Model E-4

Paravox Models VH and VL
Paravox Model XT
Paravox Model XTS
Paravox Model Y (YM, YC and YC-7)
Precision Table Hearing Aid

Radioear Model 45-CM
Radioear Model 45-M-magnetic air conduction receiver
Radioear Model 45-M-magnetic bone conduction receiver
Radioear Permo-Magnetic Uniphone
Radioear Permo-Magnetic Multipower
Ravox (Semi-Portable)

Silver Micronic Hearing Aid, Model 101
Silver Micronic Hearing Aids, Models 202M & 202C
Sonotone Audicles Nos. 530, 531 and 533
Sonotone Model 600
Sonotone Model 700
Sonotone Model 900
Superfonic Hearing Aid

Televox Model E
Telex Model 22
Telex Model 97
Telex Model 612
Telex Model 900
Telex Model 1020
Telex Model 1550
Tonemaster Model Royal
Trimm Vacuum Tube Model 300

Unex Model A

Vacolite Model J

Western Electric Ortho-tronic Model
Western Electric Model 63
Western Electric Model 64
Western Electric Models 65 & 66

Zenith Radionic Model A-2-A
Zenith Radionic Model A-3-A
Zenith Radionic Model B-3-A
Zenith Model 75

All of the accepted hearing devices employ vacuum tubes.

OFFICERS

OF THE

NATIONAL OTOLARYNGOLOGICAL SOCIETIES

American Academy of Ophthalmology and Otolaryngology

President: Dr. Conrad Berens, 35 East 70th St., New York, N. Y.
President-Elect: Dr. J. Mackenzie Brown, 1136 W. 6th St., Los Angeles, Calif.
Executive Secretary: Dr. William L. Benedict, Mayo Clinic, Rochester, Minn.

American Board of Otolaryngology

President: Dr. Arthur W. Proetz, 1010 Beaumont Bldg., St. Louis 8, Mo.
Secretary: Dr. Dean M. Lierle, University Hospital, Iowa City, Iowa.
Meeting: Chicago, October 5-6, 1949.

American Broncho-Esophagological Association

President: Dr. LeRoy A. Schall, 243 Charles St., Boston, Mass.
Secretary: Dr. Edwin N. Broyles, 1100 N. Charles St., Baltimore 1, Md.

American Laryngological Association

President: Dr. Ralph A. Fenton, 806 Medical Arts Bldg., Portland, Ore.
Secretary: Dr. Louis H. Clerf, 1530 Locust St., Philadelphia 2, Pa.
Meeting: San Francisco, Calif., 1950.

American Laryngological, Rhinological and Otological Society, Inc.

President: Dr. Robert C. Martin, 384 Post St., San Francisco 8, Calif.
Secretary: Dr. C. Stewart Nash, 708 Medical Arts Bldg., Rochester 7, N. Y.

Section Chairmen:

Eastern—Dr. Robert L. Moorhead, 125 Remsen St., Brooklyn, N. Y.
Southern—Dr. William D. Stinson, 899 Madison Ave., Memphis, Tenn.
Middle—Dr. J. Marion Sutherland, 662 Fisher Bldg., Detroit, Mich.
Western—Dr. J. B. Naftzger, 6777 Hollywood Blvd., Los Angeles, Calif.

American Medical Association, Section on Laryngology, Otology and Rhinology

Chairman: Dr. William H. Johnston, 1515 State St., Santa Barbara, Calif.
Secretary: Dr. James M. Robb, 641 David Whitney Bldg., Detroit, Mich.

American Otological Society

President: Dr. Philip E. Meltzer, 20 Charlesgate West, Boston, Mass.
Secretary: Dr. Gordon D. Hoople, Medical Arts Bldg., Syracuse 3, N. Y.

II Pan-American Congress of Otorhinolaryngology and Broncho-Esophagology

President: Dr. Justo Alonso.
Secretary: Dr. Pedro Regules, San José 1092, Montevideo, Uruguay.
Meeting: Montevideo—Buenos Aires, January 8-15, 1950.